# ATOMKI

# ANNUAL REPORT

# 1983

INSTITUTE OF NUCLEAR RESEARCH
OF THE HUNGARIAN ACADEMY OF SCIENCES
DEBRECEN, HUNGARY

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# ANNUAL REPORT

17 JANUARY 1983 - 16 JANUARY 1984

# ATOMKI

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# PREFACE

With this Annual Report we intend to give a brief survey of the scientific activity of the Institute of Nuclear Research of the Hungarian Academy of Sciences in 1983.

Our review is based mainly on the publications and on the papers submitted for publication in the last year. Some of the articles printed in 1983 have been included in the previous report due to their submissions. In those cases we gave the data of appearance but omitted the abstracts. In addition to the publications we also report theses and seminars, and give a few status reports on the major experimental facilities and projects of ATOMKI.

The subject is classified according to the main fields of research in this institute. The original language is indicated only if it is not English.

The editor thanks Mrs. A. Darin for gathering the material and preparing the author index.

J. Cseh

# NUCLEAR PHYSICS

TRANSITION DENSITY OF CHARGE-EXCHANGE PROCESSES

R. G. Lovas

Submitted to Phys. Rev. C

The transition density $\Delta\varrho$ of $(\pi^+, \pi^0)$, $(\pi^0, \pi^-)$, $(p,n)$, $(^3He,t)$ etc. charge-exchange processes leading to analogue states is usually identified either with the neutron-proton density difference, $\varrho_{np}$, or with the density of the neutron excess (n.e.), $\varrho^{n.e.}$. These two quantities may only be equal if the interactions in the nucleus do not distinguish between neutrons and protons. It was recently poroposed [1] that, at least for nuclei of small n.e., the correct prescription is $\Delta\varrho = \varrho^{n.e.}$.

We have constructed formulae and made estimates for $\Delta\varrho$ in a single-particle model in which the interactions that distinguish protons from neutrons, the Coulomb and the asymmetry potentials, are treated as first-order perturbations. Their effect is assumed to consist in mixing the unperturbed state with the (discrete) isovector monopole state. It is found that the condition for $\Delta\varrho = \varrho^{n.e.}$ to hold is that the effect of the n.e. on the mixing be disregarded. The n.e. affects the mixing in three ways: (1) it splits the isovector monopole level; (2) proton excitations to and neutron excitations from the states occupied by the n.e. contribute to the monopole; (3) the n.e. polarizes the self-conjugate core via the asymmetry potential. In the tail of $\Delta\varrho(r)$ ($1.3A^{\frac{1}{3}}$ fm$<r<1.75A^{\frac{1}{3}}$fm, A being the mass number), which dominates the charge-exchange transitions, the perturbative contributions $i$ ($i$ =1, 2, 3) to $\Delta\varrho$ are expected to be more or less proportional to $\varrho^{n.e.}(r)$. Our estimates for the factors of proportionality show that in this region correction (1) is negligible, correction (2) is only significant for heavy nuclei, but the core polarization (3) is appreciable throughout. We suggest that the Coulomb effect [corrections (1)+(2)] may explain the departure from the Lane model found for heavy nuclei [2]. Moreover, we argue that the corrections for $r>1.75A^{\frac{1}{3}}$ fm must be much larger relative to $\varrho^{n.e.}$ than those for $r<1.75A^{\frac{1}{3}}$ fm. This effect may account for the anomaly in the $0^o$ pion charge-exchange cross sections [3]. For actual calculations of $\Delta\varrho$ we suggest to use the isospin-projected Hartree-Fock model [4] modified so that all $\Delta T=0, \pm1$ isospin admixtures be included in the analogue state.

[1] N. Auerbach and Nguyen Van Giai, Phys. Rev. C24 (1981) 782
[2] S. D. Schery et al., Nucl. Phys. A234 (1974) 109
[3] H. W. Baer et al., Bull. Am. Phys. Soc. 26 (1981) 607
[4] E. Caurier and A. Poves, Nucl. Phys. A385 (1982) 407

CLUSTER APPROACH TO THE DWBA DESCRIPTION OF TRANSFER REACTIONS

K. F. Pál, R. G. Lovas, M. A. Nagarajan[1)], B. Gyarmati and T. Vertse

[1)]Daresbury Laboratory, Warrington, UK

Contributions to the 10th International Conference on Few-Body problems in Physics, Karlsruhe, 21-27 August, 1983, ed. B. Zeitnitz, p. 215.

MICROSCOPIC DESCRIPTION OF $^{7}$Li and $^{7}$Be FOR THE DWBA TREATMENT OF CLUSTER TRANSFER REACTIONS

K.F. Pál, R.G. Lovas, M.A. Nagarajan[1)], B. Gyarmati and T. Vertse

[1)]Science and Engineering Research Council Daresbury Laboratory, Daresbury, Warrington WA4 4AD, UK

Nuclear Physics A402 (1983) 141

GENERATOR-COORDINATE CALCULATION OF THE POTENTIAL OVERLAP FOR THE DWBA DESCRIPTION OF CLUSTER TRANSFER REACTIONS

R.G. Lovas, K.F. Pál and M.A. Nagarajan[1)]

[1)]Science and Engineering Research Council Daresbury Laboratory, Daresbury, Warrington WA4 4AD, UK

Nuclear Physics A402 (1983) 114

DESCRIPTION OF THE RELATIVE MOTION OF α-PARTICLE AND NUCLEAR CORE IN α-TRANSFER REACTIONS

F.K. Pál

PhD Thesis, Kossuth University, Debrecen, 1982
(In Hungarian)

TRANSITION DENSITY FOR SINGLE CHARGE-EXCHANGE SCATTERING OF PIONS

R.G. Lovas

Proc. Int. Conf. on high-energy nuclear physics, Balatonfüred, Hungary, 6-11 June, 1983

COMMENT ON "ENERGY DEPENDENCE VERSUS ANGULAR MOMENTUM DEPENDENCE OF OPTICAL POTENTIALS"

R.G. Lovas and K.F. Pál

Submitted to Phys. Rev. C

Bauhoff recently showed that, for a broad class of practically used energy dependent optical potentials, it is possible to construct an energy independent and angular momentum dependent but otherwise local equivalent potential. We have pointed out that some of Bauhoff's final formulae are incorrect, but that does not change any of the essential points. We have also proved that the energy independent equivalent potential is unique.

A POWERFUL APPROXIMATION METHOD AS APPLIED TO ONE-BODY PROBLEMS

B. Gyarmati

Seminar talk at the Nuclear Physics Laboratory, Oxford
4th May, 1983

SINGLE-PARTICLE RESONANT STATES IN DEFORMED POTENTIALS

B. Gyarmati, A. T. Kruppa, Z. Papp and G. Wolf

Submitted to: Nuclear Physics A

It is shown that the approximation scheme to the Schrödinger equation with purely out-going asymptotics that is based on the separable expansion of the potential (PSE method) can be extended into the wave number region $k = \varkappa - i\gamma$ with $0 < \gamma < \varkappa$. This extended scheme is proved to be equivalent with the analytic continuation of the homogeneous Lippmann-Schwinger equation into the same region. So its solutions are the Gamow states. As the PSE method handles spherical and non-spherical potentials on equal footing it is able to yield Gamow states in deformed potentials.

A NEW ATTEMPT TO CALCULATE THE IMAGINARY PART OF THE HEAVY ION OPTICAL POTENTIAL

M. Herzog[1)], R. Liotta[1)], T. Vertse:

[1)] Forskningsinstitutet för Atomfysik

Seminar talk at the
Åbo Academy, Turku, Sept. 30, 1983

CONTRIBUTION OF DIRECT PROCESSES TO THE OPTICAL POTENTIAL

T. Vertse

Seminar talk at the
Université de Grenoble,
Institut des Sciences Nucléaires, Grenoble Dec. 9. 1983

ENERGY DEPENDENCE OF THE CROSS-SECTION OF THE PROCESSES $^{116,120}$Sn(p,p)$^{116,120}$Sn NEAR THE COULOMB-BARRIER AND THE JLM OPTICAL POTENTIAL

T. Vertse, L. Zolnai

Submitted to 34rd Conference on Nuclear Spectroscopy on Nuclear Structure, Alma-Ata, 1984.

(In Russian)

EXPLANATION OF INTERNAL CONVERSION ANOMALIES BY GENERALIZED EXCHANGE CORRECTION

E. Vatai

Submitted to Nuclear Physics A

ON THE FINE STRUCTURE OF THE RMS RADIUS

L. Végh

Submitted to the Acta Phys. Hung.

The fine structure of nuclear rms charge radii found in experimental data for isotopic and isotonic sequences[1]) is discussed within a phenomenological treatment. We give a simple model based on the two-parameter Fermi-distribution where the shell effects can be well explained by small surface changes. It is demonstrated that the polarization effect responsible for the fine structure can be described by the degree of the valence shell occupation. The model with one free parameter provides a good description for isotopic and isotonic sequences[2]), as presented in Fig. 1.

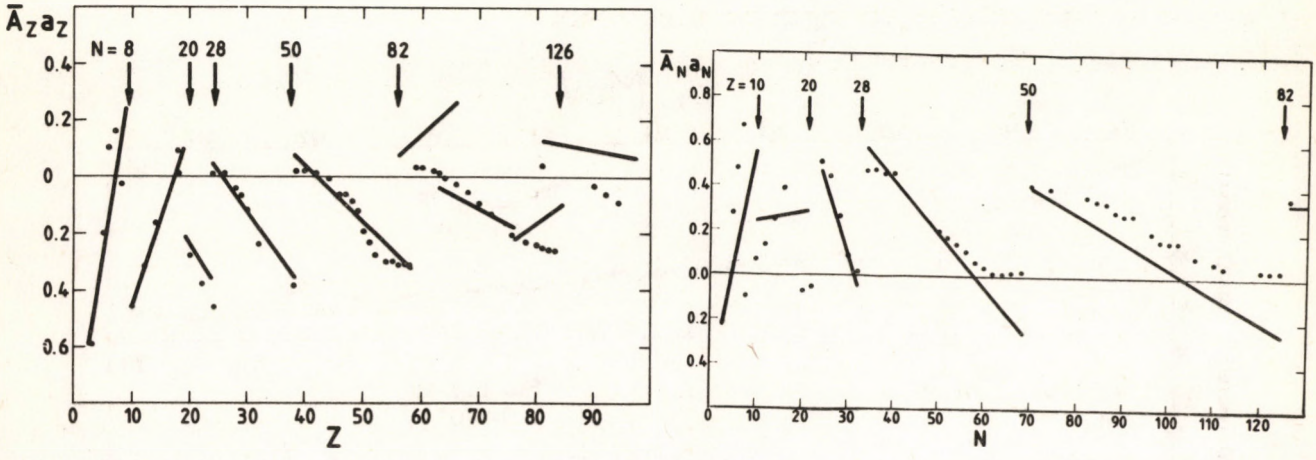



Fig.1: a) The $a_Z$ slopes of normalised rms radii for isotopic sequences multiplied by the average mass numbers $A_Z$ as a function of atomic numbers. The solid lines show the experimental trends[1]), circles denote the calculated values[2]).
b) The same for isotonic sequences.

1) I. Angeli and M. Csatlós Nucl. Phys. A288 (1977) 480
" ATOMKI Közlemények, 20 (1978) 1
2) L. Végh, Dubna Preprint E4-81-636 (1981)

"GIUSI" AN R-MATRIX PROGRAM FOR DETERMINATION OF RESONANCE PARAMETERS FROM DIFERENTIAL CROSS SECTION OF COMPOUND NUCLEAR-REACTIONS

L. Zolnai

Prikladnaya Yadernaya Spectrosopiya Vyp. 11, 1982 p. 82.

(In Russian)

LEVELS IN $^{23}$Na EXCITED BY THE $^{19}$F(α,α)$^{19}$F, $^{19}$F(α,γ)$^{23}$Na AND $^{19}$F(α,p)$^{22}$Ne REACTIONS

J. Cseh, E. Koltay, Z. Máté, E. Somorjai and L. Zolnai

Submitted to Nuclear Physics A

Excitation functions have been measured at five angles for $^{19}$F(α,α)$^{19}$F up to $E_\alpha$=3.7 MeV. The excitation curves for the $^{19}$F(α,γ)$^{23}$Na, $^{19}$F(α,$p_0$)$^{22}$Ne and $^{19}$F(α,$p_{1\gamma}$)$^{22}$Ne reactions were also obtained in simultaneous measurements. Multi-level R-matrix calculation was used to analyse the elastic scattering data yielding parameters for 16 resonances. 60 resonances corresponding to levels in $^{23}$Na were seen in the different reactions. A comparison of resonance energy and total width data is given.

The $^{19}$F(α,γ)$^{13}$Na reaction below $E_\alpha$=2.3 MeV was studied also with the help of thick target measurements. Decay scheme for two resonances are given. The α-particle strength is discussed.

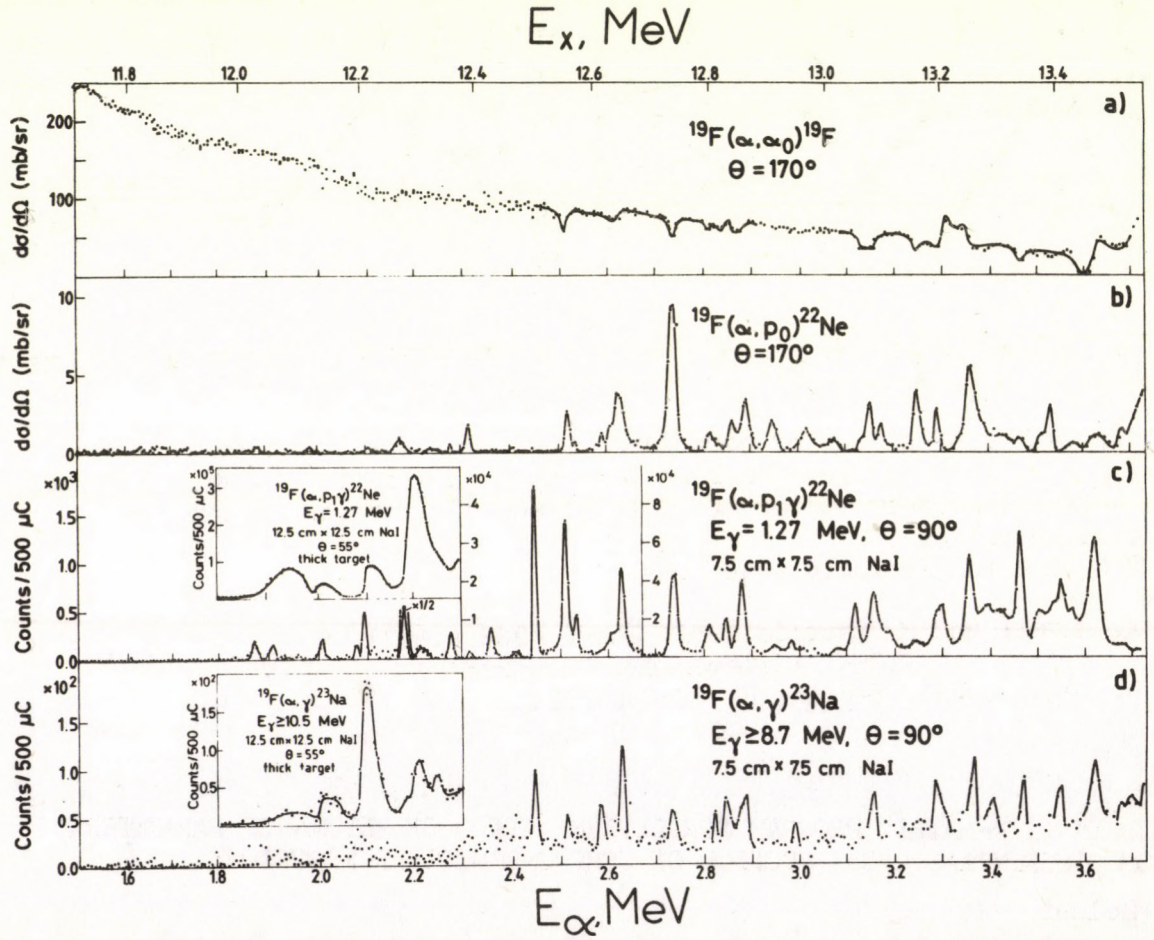



Fig.1. Comparison of excitation functions simultaneously measured in the different $^{19}$F+α processes. Thick target yields are also shown on inserts. The solid line is a theoretical fit in part (a) and a guide to the eyes on other parts

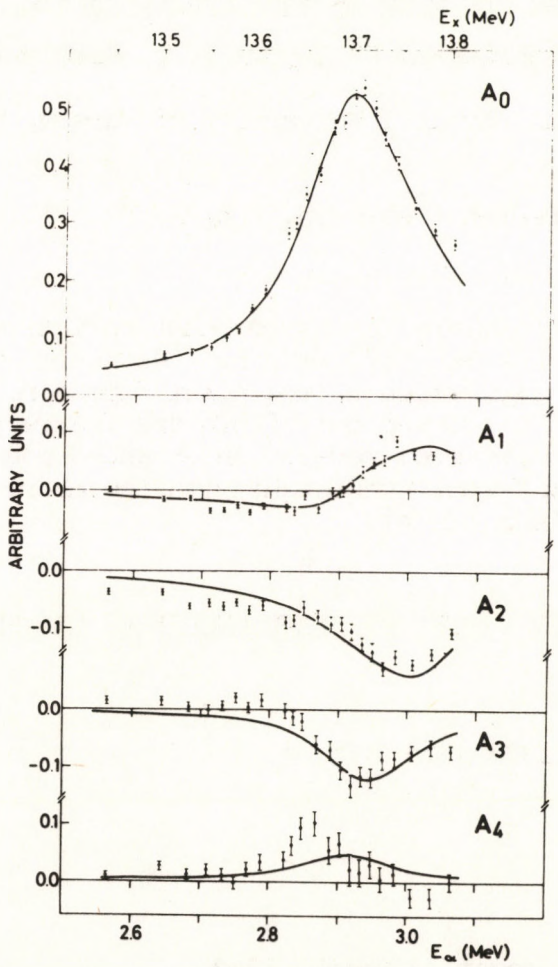
LEVELS OF $^{14}$N NEAR 13.7 MeV EXCITATION FROM THE ANALYSIS OF DOPPLER BROADENED γ-LINE SHAPES IN THE $^{10}$B(α,pγ)$^{13}$C REACTION

J. Cseh. Á. Z. Kiss, E. Koltay, B. Nyakó and É. Pintye[1)]

[1)]Clinic of Radiology, Dept. of Radiation Therapy, Medical University, Debrecen, Hungary

Nuclear Physics A410 (1983) 147-155

Excitation function has been measured in the $^{10}$B(α,pγ)$^{13}$C reaction by γ-detection. Enriched target and Ge(Li) detector have been used. The Doppler broadened γ-line shape has been analysed resulting in the angular distribution of protons in each energy point. Via R-matrix analysis of these distributions parameters of three resonances have been determined.




The Legendre coefficients $A_L$ for L=0 to 4 as the function of α-energy, in arbitrary units. The solid lines represent the best fit from the R-matrix analysis.

ANALYSIS OF THE $^{27}Al(p,\gamma)^{28}Si$ REACTION AT SUBBARRIER ENERGIES IN TERMS OF THE DIRECT-SEMIDIRECT MODEL

M. Kicinska-Habior[1)], P. Decowski[1)], M. Dabrowska[1)], W. Grochulski[1)], P. Jaracz[1)], T. Matulewicz[1)], B. Sikora[1)], J. Tőke[1)] and E. Somorjai

[1)]Institute of Experimental Physics, University of Warsaw, Poland

Z. Phys. A - Atoms and Nuclei 312, 89-93 (1983)

Differential cross sections for $\gamma$-transitions to 12 states in $^{28}Si$ following nonresonant proton capture in $^{27}Al$ nuclei ($E_p$=1625 keV) were measured and analysed in terms of the direct-semidirect model. The experimental data are reproduced only when the complex coupling constant with the GDR is enhanced for the *f* partial wave in the entrance channel.

VIRTUAL EXCITATION OF THE GDR MODE IN THE SUBBARRIER $^{23}Na(p,\gamma)^{24}Mg$ REACTION

M. Kicinska-Habior, M. Dabrowska, P. Decowski, T. Matulewicz, B. Sikora and J. Toke
Institute of Experimental Physics, University of Warsaw, Poland
and
J. Cseh and E. Somorjai
Institute of Nuclear Research, Debrecen, Hungary

Submitted to the Zeitschrift für Physik A.

Differential cross sections for nonresonant radiative capture of low energy protons ($E_p$=1348 keV and 1370 keV) by $^{23}Na$ nuclei exhibit features pointing to the virtual excitation of the giant dipole resonance (GDR) mode. Theoretical analysis carried out within the framework of the direct - semidirect capture model reveals an enhanced coupling of the GDR with the incident proton f-wave consistent with the microscopic structure of the GDR in the s-d shell nuclei.

QUASIMOLECULAR AND CLUSTER STATES OF LIGHT NUCLEI AS EXAMPLES OF INTERMEDIATE STRUCTURE

J. Cseh

Journal of Physics G. 9 (1983) 655

SUPERSYMMETRY IN NUCLEI

J. Cseh

Seminar talk at KFKI, Budapest, 3 March, 1983

(In Hungarian)

ANALYSIS OF RESONANCES IN THE $^{24}Mg(^{16}O,^{16}O)^{24}Mg(2^+,1.37\ MeV)$ REACTION

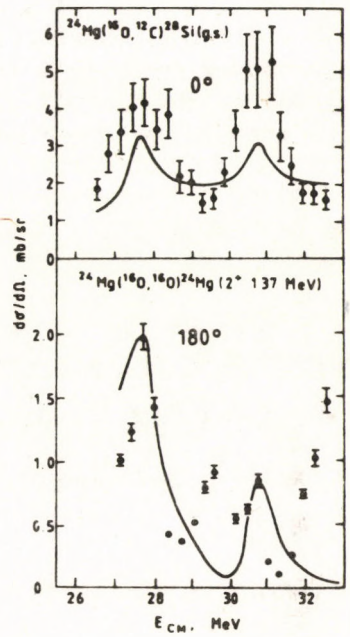
T. Papp, J. Cseh, T. Vertse

Proc. Int. Conf. Nucl. Phys. Florence, 1983, p. 632

Heavy ion resonances have been analysed in a few cases by decomposing the reaction amplitude into resonant and background term. In each reaction investigated so far [1,2] all the participating nuclei had spin zero. We have generalized this method for non-zero channel--spins.

Rhe R-matrix formalism has been modified so that the collision matrix be a sum of a usual resonant part [3] and a background part. The latter one is expressed in terms of the DWBA radial integrals, calculated by the ZR code DWUCK, using formulae (A.17, A.18) of Satchler [4].

We considered the inelastic scattering of $^{16}O$ on $^{24}Mg$ [5] as an example in order to decide if the resonances found in the $^{24}Mg\ (^{16}O,\ ^{12}C)^{28}Si$ transfer process [1] show up in inelastic scattering as well. The answer is affirmative, as one can see in the figure where the curves are calculated with $\Gamma_{in}x\Gamma_{out}=0.15MeV^2$ and $0.0032MeV^2$ strengths.





[1] S. J. Sanders et. al., Phys. Rev. C21 (1980) 1810
[2] P. Braun-Munzinger et. al., Phys. Rev. C24 (1981) 1010
[3] S. M. Blatt, L. S. Biedenharn, Rev. Mod. Phys. 24 (1952) 258
[4] G. R. Satchler, Nucl. Phys. 55 (1964) 1
[5] M. Paul et. al., Phys. Rev. C21 (1980) 1802


NUCLEAR STATES OF CORE+α-PARTICLE TYPE AND THE INTERACTING BOSON MODEL

J. Cseh

Izv. Akad. Nauk SSSR, Ser. Phys. 47 (1983) 80

(In Russian)

DYNAMICAL SYMMETRIES OF THE U(4) MODEL AND HIGH-LYING STATES IN THE $^{20}Ne$, $^{28}Si$, AND $^{30}Si$ NUCLEI

J. Cseh

Pysical Review C 27 (1983) 2991

SHORT LIFETIMES IN $^{26}$Al

J. Keinonen[1], B. Nyakó, A. Luukkainen[1] and A. Anttila[1]

[1]Department of Physics, University of Helsinki, SF-00170 Helsinki, Finland

Nuclear Physics A403 (1983) 45 56

Mean lifetimes of levels in $^{26}$Al have been measured using the Doppler-shift attenuation (DSA) method and the reaction $^{25}$Mg(p,γ)$^{26}$Al. The lifetime values or limits were determined for 34 bound levels below the excitation energy of 6 MeV: the lifetimes of 13 levels and upper limits of 3 levels are reported for the first time. For the effective stopping of recoils, the targets were prepared by implanting $^{25}$Mg into Ta backings. The Monte Carlo method and the experimental stopping power were used in the DSA analysis.

THE EFFECT OF THE PROPERTIES OF SLOWING MEDIA ON NUCLEAR LIFETIMES DERIVED FROM DSA MEASUREMENTS

M. M. Abdel Hady[1], Á. Z. Kiss, E. Koltay, B. Nyakó, M. Hautala[2]

[1]Ain Shams University, Cairo, Arab Republik of Egypt
[2]Department of Physics, University of Helsinki, SF-00170 Helsinki 17, Finland

Submitted to: Acta Phys. Hung.

Apparent lifetimes determined from Doppler Shift Attenuation (DSA) measurements are known to depend on the atomic number $Z_2$ of the stopping medium. It is shown here that inaccuracies in the data of the medium will result in additional fluctuation as the function of $Z_2$.

The determination of the actual conditons of the slowing medium helps in avoiding systematic errors in the evaluation. On the other hand the use of experimentally determined range values for the proper selection of parameters $f_e$ and $f_n$ decreases the $Z_2$ dependence of apparent lifetimes.

The above effects are investigated in the case of the 6.2 MeV excited state of $^{14}$N excited in the $^{13}$C(p,γ)$^{14}$N nuclear reaction.

INVESTIGATION OF EXCITED STATES OF $^{29}$P IN THE $^{28}$Si(p,p)$^{28}$Si REACTION

P. Manngord[1], M. Brenner[1], Z. Veress[2], L. Zolnai, Z. Máté

1) Department of Physics, Abo Akademi, Turku
2) Bajcsy-Zsilinszky Endre Technical School, Ujfehértó

34rd Conference on Nuclear Spectroscopy and Nuclear Structure, Alma-Ata, 1984.

ALPHA-PARTICLE INDUCED RESONANCES IN $^{28}$Si NUCLEUS

E. Somorjai

Thesis for the candidate of science degree

(In Hungarian)

ELASTIC SCATTERING OF CHARGED PARTICLES OF LOW ENERGY

L. Zolnai

Thesis for the candidate of science degree

(In Hungarian)

RESONANT REACTIONS OF LIGHT NUCLEI AND NUCLEAR QUASIMOLECULES

J. Cseh

Thesis for the candidate of science degree

(In Hungarian)

A PLUNGER DEVICE FOR LIFETIME MEASUREMENTS OF EXCITED NUCLEAR LEVELS AND ITS TEST IN THE $^{19}F(\alpha p\gamma)^{22}Ne$ REACTION

M. Józsa

Diploma thesis Kossuth University, 1983

(In Hungarian)

EXPERIMENTS ON NUCLEAR SPECTROSCOPY OF LIGHT NUCLEI WITH THE BEAM OF A VAN DE GRAAFF ACCELERATOR

J. Cseh, Á.Z. Kiss, E. Koltay, Z. Máté, B. Nyakó, É. Pintye, E. Somorjai, L. Zolnai

Seminar talk at the Department of Physics, University of Jyväskylä, Finland 3rd Oct, 1983

INVESTIGATION OF THE RESONANCES IN $^{19}F+\alpha$ and $^{24}Mg+\alpha$ PROCESSES BELOW 5 MeV BOMBARDING ENERGY

J. Cseh, E. Koltay, Z. Máté, E. Somorjai and L. Zolnai

Dept. of Physics, Åbo Academy, Turku, Finland 6st Sept, 1983

RESONANCES IN ALPHA RADIATIVE CAPTURE OF FLUORINE

J. Cseh, E. Koltay, Z. Máté, E. Somorjai and L. Zolnai

Europhysics Study Conference on Frontiers of $\gamma$- and X-ray Spectroscopy, Crete - Greece, June 27 - July 1, 1983

EXCITED STATES OF THE $^{70}$Ga NUCLEUS

T. Fényes, J. Gulyás, T. Kibédi, A. Krasznahorkay, J. Timár, S. Brant* and V. Paar*

*Prirodoslovno-matematički fakultet, University of Zagreb, 41000 Zagreb, Yugoslavia

Submitted to Nuclear Physics A

The γ-spectrum of the $^{70}$Zn(p,nγ) $^{70}$Ga reaction was measured with Ge(Li) spectrometers at 3, 3.5 and 4 MeV bombarding proton energies. 47 γ-rays were assigned to $^{70}$Ga and the energies ($E_\gamma$) and relative intensities ($I_\gamma$) of γ-rays were determined. The electron spectrum of the reaction was measured with high transmission superconducting magnet transporter Si(Li) and mini-orange Si(Li) spectrometers. Internal conversion electron ceofficients were determined for eight $^{70}$Ga transitions. The level scheme of $^{70}$Ga, γ-branching ratios, multipolarity of transitions, level spin and parities were deduced. The energies of low-lying $^{70}$Ga levels were calculated on the basis of the parabolic rule derived from the cluster-vibration model. This calculation provided a simple classification of several multiplet states in $^{70}$Ga for the first time (Fig. 1).

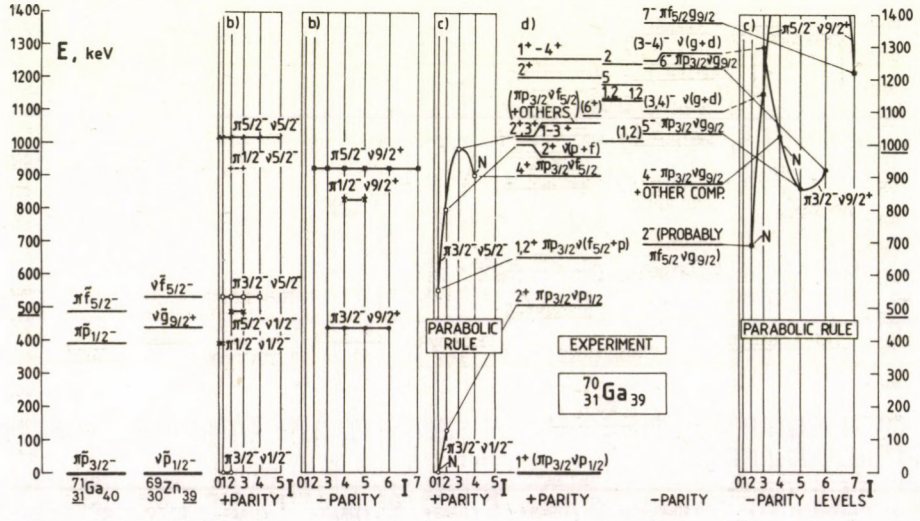



Fig. 1. Proton-neutron quasi-particle multiplet states in $^{70}$Ga.
a) Experimental level energies and configurations of the lowest three states of the $^{71}$Ga and $^{69}$Zn nuclei.
b) The zeroth-order classification of the low-lying $^{70}$Ga states. I is the spin of the nuclear state.
c) The splitting of some states of Fig. 1b due to quadrupole and spin vibrational phonon exchange. N means normalization point.
d) Experimental levels of $^{70}$Ga below ~1300 keV.

EXCITED STATES OF $^{82}$Br FROM (p,nγ) REACTION

T. Fényes, Z. Gácsi, J. Gulyás, T. Kibédi, A. Krasznahorkay, S. László, D. Novák, S. Brant* and V. Paar*

*Prirodoslovno-matematički fakultet, University of Zagreb, 41000 Zagreb, Yugoslavia

Submitted to Physica Scripta

γ-ray and internal conversion electron spectra of the $^{82}$Se(p,nγ)$^{82}$Br reaction were measured with Ge(Li) and superconducting magnet transporter Si(Li) spectrometers respectively, at 3.5 and 4 MeV bombarding proton energies. The level scheme of $^{82}$Br, multipolarities of 11 transitions, γ-branching ratios, level spin and parity values have been deduced. The energies of $^{82}$Br levels were calculated on the basis of the parabolic rule derived from the cluster-vibrational model. This calculation provided a simple classification of several multiplet states in $^{82}$Br (see Fig.).

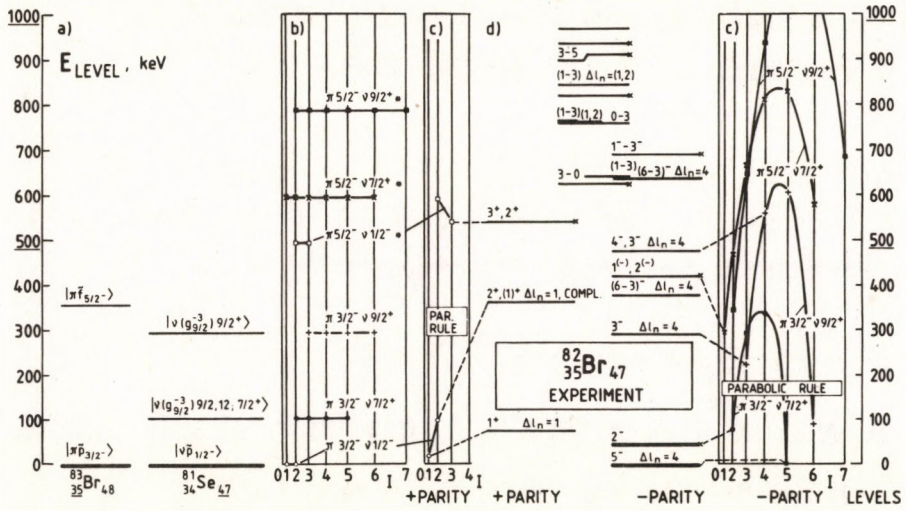



Fig. Multiplet states in $^{82}$Br.
a/ Experimental level energies and probable configurations.
b/ The zeroth-order classification of several $^{82}$Br multiplets. I is the spin of the nuclear state.
c/ The splitting of the multiplets due to quadrupole and spin vibrational phonon exchange.
d/ Experimental levels of $^{82}$Br below 1000 keV. (The $\Delta l_n$ values were taken from (d,p) reaction studies.)

LOW-LYING STATES OF THE $^{102}$Rh NUCLEUS

Zs. Dombrádi, A. Krasznahorkay, J. Gulyás

Zeitschrift für Physik-A A313 (1983) 207-211.

The γ-spectra and γ-excitation functions of the $^{102}$Ru(p,nγ)$^{102}$Rh reaction were measured with Ge(Li) and hyperpure Ge spectrometers at various bombarding proton energies between 3.20 and 4.05 MeV. The γ-ray energies and intensities as well as the γ threshold energies were determined, and 43 new γ-rays were assigned to the $^{102}$Rh nucleus. γγ-coincidence measurements were performed too at 4 MeV bombarding proton energy with Ge(Li) spectrometers. The level scheme of $^{102}$Rh was deduced up to 580 keV excitation energy and 12 previously unobserved levels were placed in the scheme.

EXCITED STATES OF $^{82}$Br FROM (p,nγ) REACTION

T. Fényes, Z. Gácsi, J. Gulyás, T. Kibédi, A. Krasznahorkay, S. László, D. Novák; S. Brant[1], V. Paar[1]

[1]Theoretical Physics Department, University of Zagreb

Proc. Int. Conf. Nucl. Phys., Florence, 1983, p. 263

EXCITED STATES OF $^{76}$As

Z. Gácsi, J. Gulyás, T. Kibédi, E. Koltay, A. Krasznahorkay and T. Fényes

Izv. Akad. Nauk SSSR, Ser. Fis. 47 (1983) No 1, 45-51

DESCRIPTION OF Gd ISOTOPES IN IBA

Z. Árvay, B. Alikov[1], J. Kvasil[1], R. Nazmitdinov[1], I. Sharonov[1]

[1]Joint Institute for Nuclear Research, Dubna, USSR

Submitted to the Int. Symp. In-beam Nuclear Spectroscopy, Debrecen, May 14-18, 1984

PROTON-NEUTRON EFFECTIVE INTERACTION IN $^{96}$In

B.D. Kern[1], T. Fényes, Zs. Dombrádi, A. Krasznahorkay, T. Vertse, S. Brant[2], and V. Paar[2]

[1]University of Kentucky, Department of Physics and Astronomy, USA

[2]Theoretical Physics Department of the University of Zagreb, Yugoslavia

Meeting of the Nuclear Physics Division of the American Physical Society, University of Notre Dame 13-15 October, 1983

EXCITED STATES OF THE $^{76}$As AND $^{82}$Br NUCLEI

Z. Gácsi

PhD. Thesis, Kossuth University, Debrecen, 1983,
(In Hungarian)

This dissertation gives an account of the investigation of the structure of $^{76}_{33}As_{43}$ and $^{82}_{35}Br_{47}$ nuclei. In the first part the main features of the surrounding even-even nuclei are surveyed and former experimental results on $^{76}$As and $^{82}$Br nuclei are summarized. In the next chapter the experimental instruments and methods applied in our investigations are reviewed. In the third part the results obtained for $^{76}$As and $^{82}$Br nuclei are presented.

Gamma and internal conversion electron spectra of the $^{76}$Ge(p,nγ)$^{76}$As reaction were measured with Ge(Li) and superconducting magnetic transporter Si(Li) spectrometers respectively, at 3.2 MeV bombarding proton energy. Multipolarities for 23 transitions in $^{76}$As have been determined for the first time. Level scheme has been constructed and spins and parities for 20 levels of $^{76}$As have been deduced. The proposed scheme of excited states is compared with data of former experimental works and with results of theoretical calculations based on the shell model.

Gamma and internal conversion electron spectra of the $^{82}$Se(p,nγ)$^{82}$Br reaction were measured with Ge(Li) and superconducting magnetic transporter Si(Li) spectrometers respectively, at 3.5 and 4 MeV bombarding proton energies. The level scheme of $^{82}$Br, multipolarities of 11 transitions, gamma-branching ratios, level spin and parity values have been deduced. First in the literature the energies of $^{82}$Br levels were calculated on the basis of the parabolic rule derived from the cluster-vibration model. This calculation provided a simple classification of several multiplet states in $^{82}$Br.

The results have been published in [1,2] works.

[1] Z. Gácsi, J. Gulyás, T. Kibédi, E. Koltay, A. Krasznahorkay and T. Fényes, Izv. AN SSSR ser. fiz. 47, No 1, (1983)

[2] T. Fényes, Z. Gácsi, J. Gulyás, T. Kibédi, A. Krasznahorkay, S. László, D. Novák, S. Brant, V. Paar, Accepted for publication in Physica Scripta

## EXCITED STATES OF THE $^{98}$Tc NUCLEUS

T. Kibédi

PhD. Thesis, Kossuth University, Debrecen, 1983,
(In Hungarian)

The aim of the present work was the investigation of the structure of the $^{98}$Tc nucleus.

In the first part of the dissertation a survey of literature on the $^{98}$Tc nucleus is given and a description of the experimental instruments and methods. The conversion electron spectra were measured with a superconducting magnet transporter Si(Li) spectrometer. A method was proposed for the efficiency calibration of the spectrometer and the electron transmission properties of the spectrometer were investigated in detail.

The $\gamma$ and internal conversion electron spectra of the $^{98}$Mo(p,n$\gamma$)$^{98}$Tc reaction were measured with Ge(Li) and superconducting magnet transporter Si(Li) spectrometers, respectively at 4 MeV bombarding proton energy. The level scheme of $^{98}$Tc, $\gamma$-branching ratios, multipolarity of transitions, level spin and parity values have been deduced. Multipolarity of ten transitions and many level spin and parity values have been determined.

The energies of $^{98}$Tc levels were calculated on the basis of the parabolic rule derived from the cluster-vibration model. The comparison of the experimental and theoretical level schemes made possible the identification of many multiplet states for the first time.

The obtained results were published in [1,2].

1. Z. Árvay, T. Fényes, J. Gulyás, T. Kibédi, E. Koltay, A.Krasznahorkay, S. László, D. Novák, S. Brant and V. Paar, Phys. Scripta 26 (1982) 57.
2. Z. Árvay, T. Fényes, K. Füle, T. Kibédi, S. László, Z. Máté, Gy. Mórik, D. Novák and F. Tárkányi, Nucl. Instr. and Meth. 178 (1980) 85.

## IDENTIFICATION OF THE PROTON DRIP LINE

G.D. Alkhazov[1], K.A. Mezilev[1], Yu.N. Novikov[1], Nurmukhamedov[1], N. Ganbaatar[2], K.Ya. Gromov[3], V.G. Kalinnikov[3], A. Potempa[3] and F. Tárkányi

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Zeitschrift Phys. A311 (1983) 245

A group of proton emitters of Au, Ir, Re, Ta has been identified by means of mass values derived from the experimental data. The proton drip line has been determined. It is shown that on the boundary of the proton stability the values of proton pairing energies increase by about 50% as compared with the isotone nuclei near the beta-stability line.

NEW ISOMERIC STATES IN $^{131}Pr$, $^{138}Pm$, $^{146}Tb$ ISOTOPES

N. Ganbaatar[1], J. Kormicki[2], K.A. Mezilev[3], Yu.N. Novikov[3], A.M. Nurmukhamedov[3], A. Potempa[2], J. Sieniawski[2], F. Tárkányi

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983
(In Russian)

CONVERSION ELECTRON MEASUREMENTS IN THE DECAY OF SHORT-LIVED Ho NUCLEI

N. Ganbaatar[1], J. Kormicki[2], K.A. Mezilev[3], Yu.N. Novikov[3], A.M. Nurmukhamedov[3], A. Potempa[2], J. Sieniawski[2], F. Tárkányi

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983
(In Russian)

MASS DIFFERENCE MEASUREMENTS IN RARE-EARTH NUCLEI FAR FROM THE BETA STABILITY

G.D. Alkhazov[1], A.A. Akhmonen[1], L.Kh. Batist[1], Yu.S. Blinnikov[1], N. Ganbaatar[2], K.Ya. Gromov[3], Yu.V. Yelkin[1], V.G. Kalinnikov[3], K.A. Mezilev[1], F.V. Moroz[1], Yu.N. Novikov[1], A.M. Nurmukhamedov[1], B.N. Panteleyev[1], A.G. Polyakov[1], A. Potempa[4], J. Sieniawski[4], F. Tárkányi, V.K. Tarasov[1],

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983
(In Russian)

THE STUDY OF SHORT-LIVED NUCLEI IN THE REGION Z=59-68

G.D. Alkhazov[1], K.A. Mezilev[1], Yu.N. Novikov[1], N. Ganbaatar[2], K.Ya. Gromov[3], V.G. Kalinnikov[3], A. Potempa[4], E. Sieniawski[4], and F. Tárkányi

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Zeitschrift Phys. A 310 (1983) 247

THE RENORMALIZATION OF THE AXIAL-VECTOR COUPLING CONSTANT IN HEAVY NUCLEI

G.D. Alkhazov[1], N. Ganbaatar[2], K.Ya. Gromov[3], V.G. Kalinikov[3], V.I. Isakov[1], K.A. Mezilev[1], Yu.N. Novikov[1], A.M. Nurmukhamedov[4], A. Potempa[4], F. Tárkányi

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LIAF Report No 906

(In Russian)

BETA-DECAY ENERGIES OF $^{147}$Tb, $^{148}$Tb, $^{148}$Dy

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Izv. Acad. Nauk. SSSR Ser. Fiz. 47

(In Russian)

BETA-DECAY ENERGIES OF $^{143}$Eu, $^{145}$Gd AND $^{149}$Dy NUCLEI

G.V. Veselov[1], N. Ganbaatar[2], K.A. Mezilev[3], Yu.N. Novikov[3], A. Potempa[4], V.A. Sergienko[1], F. Tárkányi and V.G. Teterin[1]

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Proc. 33rd Symp. Nucl. Spectr. Nucl. Struct., Moscow, 1983, p. 99.

(In Russian)

EXCITED STATES OF THE $^{147}$Tb ISOTOPE

G.D. Alkhazov[1], N. Ganbaatar[2], K.Ya. Gromov[3], V.G. Kalinnikov[3], J. Kormicki[4], K.A. Mezilev[1], Yu.N. Novikov[1], A.M. Nurmukhamedov[1], A. Potempa[4], J. Sieniawski[4], F. Tárkányi

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983

(In Russian)

IDENTIFICATION OF THE PROTON DRIP LINE

G.D. Alkhazov[1], N. Ganbaatar[2], K.Ya. Gromov[3], V.G. Kalinnikov[3], K.A. Mezilev[1], Yu.N. Novikov[1], A.M. Nurmukhamedov[1], A. Potempa[4], F. Tarkányi

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983

(In Russian)

THE NEW ISOTOPE $^{137}$Eu. DECAY OF $^{137}$Sm ISOTOPE

G.D. Alkhazov[1], N. Ganbaatar[2], K.Ya. Gromov[3], V.G. Kalinnikov[3], J. Kormicki[4], K.A. Mezilev[1], Yu.N. Novikov[1], A.M. Nurmukhamedov[1], A. Potempa[4], J. Sieniawski[4], F. Tarkányi

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983

(In Russian)

PURE GAMOW-TELLER TRANSITIONS $0^+$-$1^+$ IN THE DECAY OF Yb, Er, Dy NUCLEI

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983

(In Russian)

APPLICATION OF A HIPERPURE GERMANIUM DETECTOR FOR PRECISE ENDPOINT ENERGY DETERMINATIONS OF CONTINUOUS POSITRON-SPECTRA

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Proc. 33rd Symp. Nucl. Spectr. Struc. Moscow, April 19-21, 1983

(In Russian)

# ATOMIC PHYSICS

ION-INDUCED $L_3$-SUBSHELL ALIGNMENT OF ARGON

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Submitted to J. Phys. B: At. Mol. Phys.

The angular distribution of the argon $L_3$-$M_{2,3}^2(^1S_0)$ Auger electrons has been measured relative to the isotropic $L_2$-$M_{2,3}^2(^3P_{0,1,2})$ transition for proton impact in the energy range 0.8-3.0 MeV, and for $H_2^+$ and $He^+$ ion impact at 0.8 MeV/amu. From the measured anisotropies alignment parameters ($A_2$) have been deduced. The results have been compared to the data measured by DuBois and Rødbro [1] as well as PWBA calculations including electron capture [2].

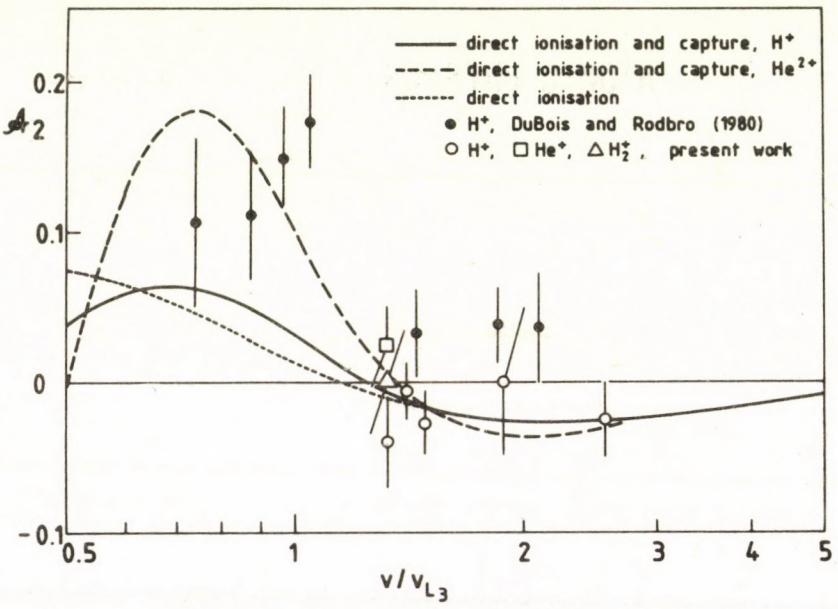



Fig. 1. $L_3$-subshell alignment parameters of argon for ion bombardment as a function of the relative collision velocity.

References

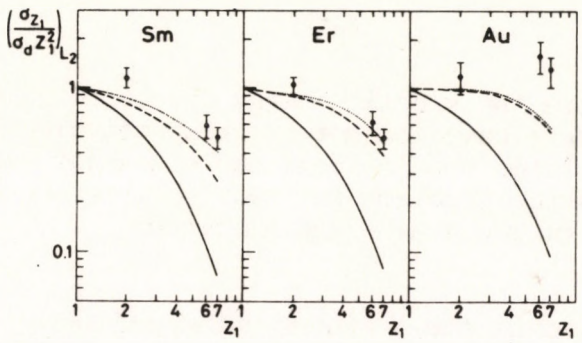
[1] R. DuBois and M.Rødbro, J. Phys. B: At.Mol.Phys. 13 (1980) 3739
[2] E. G. Berezhko, V. V. Sizov and N. M. Kabachnik, J.Phys.B: At.Mol.Phys. 14 (1981) 2635

# INVESTIGATION OF THE PROJECTILE ATOMIC NUMBER DEPENDENCE OF THE L-SUBSHELL IONIZATION

Tibor PAPP, József PÁLINKÁS, László SARKADI, Bálint SCHLENK, István TÖRÖK and Károly KISS

Paper presented at the Third Workshop on Inner Shell Ionization by Light Ions, Linz, Aug. 4-5, 1983, Austria.
Submitted to the Nucl. Instrum. and Meth.

Relative L-subshell ionization cross sections have been measured using a series of ions at a fixed collision velocity in order to study the projectile nuclear charge dependence. Thin Sm, Er, and Au targets were bombarded by $2H^+$, $4He^+$, $12C^+$, and $14N^+$ ions at 0.2 MeV/amu impact energy. The cross sections were normalized to the data obtained by deuterons. The experimental results have been compared with the predictions of the direct ionization theory using the CPSSR model as well as with the recent second order calculations. Particularly large discrepancies have been found for the $L_2$ subshell comparing the CPSSR results with the measured values. These discrepancies have been reduced significantly with the inclusion of the second order effects. See the figure.




$L_2$-subshell ionization cross sections for different bombarding ions, relative to deuteron. Experimental data: ●, theoretical curves: —— CPSSR, - - - - second order calculations, . . . . second order calculations using the united atom approach.

MULTIPLE IONISATION EFFECTS DUE TO RECOIL IN ATOMIC COLLISIONS

L. Végh

Submitted to the Journal of Physics B: At. Mol. Phys.

A description of atomic recoil excitation of the N-electron atom caused by the projectile ion is given using the two-potential formula. The Hamiltonian is split up as

$$H=H_o+V+V$$

$$H_o=T_{CM}+T_{BA}+H_A$$

$$V=\frac{Z_B Z_T e^2}{R_B-R_T}$$

$$V=\frac{-Z_B e^2}{R_B-R}$$

where $T_{CM}$ and $T_{BA}$ are the kinetic energy operators of the centre of mass and the atom- incident have ion motion, respectively, $H_A$ is the atomic Hamiltonian V describes the incident nucleustarget nucleus, V the incident nucleus-atomic electron interactions, respectively. In the two--potential formula of the scattering amplitude

the T -matrix element of the V interaction and the and scattering wave functions are calculated in impulse-approximation. The relation of the direct and recoil ionisation amplitude is disscussed demonstrating that their interference in dipol approximation may be destructive only approximately.

The characteristic feature of the large effects is the strong multiple ionisation and the strength of the satellite lines follow strictly the binomial distribution. We have estimated the cross section of the recoil ionisation in neutron induced reactions and we have obtained the =24.3 mb value for the K-shell ionisation at $E_n$=14 MeV for the $^{27}$Al atom. The multiple ionisation and the K-shell vacancy life time of recoiled ions and the recoil effects in the electron conversion coeffizients are also discussed.

Reference: L. Végh, ATOMKI Preprint B/5 (1983)

HIGHER ORDER PROCESSES IN L-SHELL IONIZATION

L. Sarkadi and T. Mukoyama*

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Submitted to Nuclear Instruments and Methods

The time-dependent perturbation theory has been applied to the description of the L-shell ionization of atoms by heavy charged particles in the independent-particle model approximation. A second order correction factor to first order (e.g. PWBA) cross sections has been derived considering transitions at an average impact parameter and with minimum energy transfer as dominant ionization processes in low-velocity collisions. Numerical calculations have been performed for light- and heavy ($Z_1 \leqslant 8$)-ion impact ionization of gold in the energy range 0.15-2.0 MeV/amu. The results are in a satisfactory agreement with the experimental data for the $L_3$- to $L_2$- and $L_1$- to $L_2$-subshell ionization cross section ratios. The model seems to account also for the anomalous behaviour of the $L_3$-subshell alignment observed recently at heavy-ion impact.

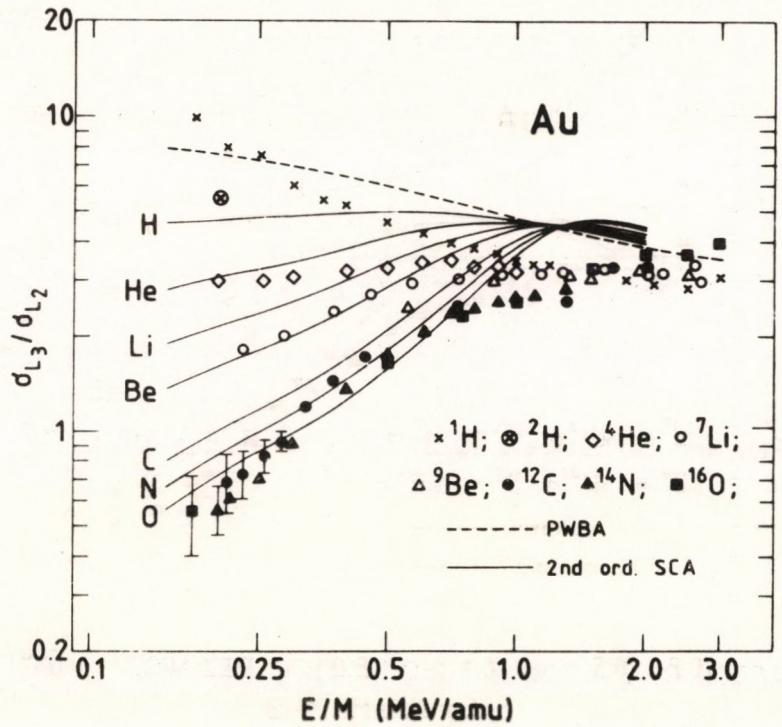


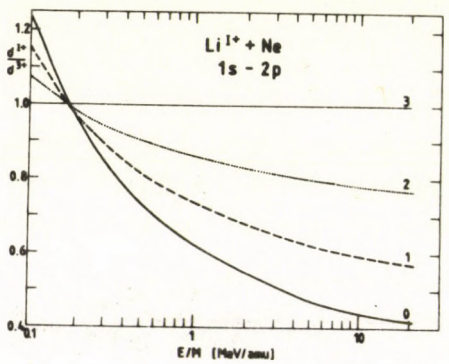

Fig.1. Comparison of the results of the present calculations with the experimental data for the $L_3$ to $L_2$ ratio. The target is gold.

THE SCREENING EFFECT OF THE PROJECTILE ELECTRONS ON THE INNER SHELL EXCITATION

L. Végh and L. Sarkadi

Submitted to the Journal of Physics B: At. and Mol. Phys.

The screening effect of the projectile electrons is investigated in the framework of the semiclassical approximation in cases of 1s-2p excitation and L-shell ionisation. This approach allows us to take into consideration the change of the screening with the impact parameter and with the position of the projectile along the path. The effect of the projectile electrons is described by Gáspár potential. The dependence of the screening effect on the projectile energy and ionic change is discussed. Figure shows the calculated ratios of the 1s-2p excitation cross section $\sigma^{1+}/\sigma^{3+}$ for $Li^{1+}$ + Ne collision with projectile ion charges I=0,1,2,3.




Reference: L. Végh and L. Sarkadi ATOMKI Preprint B/6 1983

ANGULAR DISTRIBUTION OF ELECTRONS EJECTED FROM THE ARGON L SHELL BY 350 keV PROTON IMPACT

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J.Phys.B: At.Mol.Phys. 16 (1983) 71

L-SHELL COULOMB IONIZATION

L. Sarkadi

Nucl. Inst. and Meth. 214 (1983) 43 p.

ELECTRONIC RELATIVISTIC EFFECTS IN K-SHELL IONIZATION BY PROTON IMPACT

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Phys. Rev. A. 28 (1983) p. 1303

L-SHELL IONIZATION OF GOLD BY NITROGEN-ION IMPACT

J. Pálinkás, L. Sarkadi, B. Schlenk, I. Török, Gy. Kálmán, C. Bauer[1], K. Brankoff[1], D. Grambole[1], G. Heiser[1], W. Rudolph[1], H.J. Thomas[1]

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IEEE Transactions on Nuclear Science, 30 (1983) p. 970

STUDY OF THE L-SHELL IONISATION OF GOLD BY 3.0-18.2 MeV NITROGEN-ION BOMBARDMENT

J. Pálinkás, L. Sarkadi, B. Schlenk, I. Török, Gy. Kálmán, C. Bauer[1], K. Brankoff[1], D. Grambole[1], C. Heiser[1], W. Rudolph[1] and H.J. Thomas[1]

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Submitted to Journal of Physics-B.

$L_3$-SUBSHELL ALIGNMENT OF HEAVY ATOMS IN ASYMMETRIC ION-ATOM COLLISIONS

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2) Inst. Atomic Physics, University of Stirling, Stirling, Scotland
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Int. Conf. on X-Ray and Atomic Inner Shell Physics (X-82), August 23-27, 1982, Eugene, Oregon, USA

THE KLL AUGER SPECTRUM OF MANGANESE

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Z. Phys. A - Atoms and Nuclei 311, 37-39 (1983)

The KLL Auger electrons of manganese (Z=25) emitted in the $^{55}$Fe decay were measured using an electrostatic spectrometer. The computer analysis of the spectra yielded the following intensity ratios:

$KL_1L_1:KL_1L_2:KL_1L_3:KL_2L_2:KL_2L_3:KL_3L_3$

$=(0.13\pm0.06):(0.31\pm0.02):(0.11\pm0.01)$

$:(0.11\pm0.03):(1\pm0.05):(0.07\pm0.05)$.

These data agree in all but one items within one standard deviation with the relativistic calculations in the intermediate coupling scheme with configuration interaction.

L-SHELL X-RAY PRODUCTION CROSS SECTIONS FOR LOW-ENERGY PROTONS

T. Mukoyama[1)] and L. Sarkadi

[1)] Institute for Chemical Research, Kyoty University, Kyoto, Japan

Nuclear Instruments and Methods 205 (1983) 341-346

HELIUM-INDUCED L-SHELL IONIZATION CROSS SECTIONS

T. Mukoyama[1)] and L. Sarkadi

[1)] Institute for Chemical Research, Kyoto University, Kyoto, Japan

Nuclear Instruments and Methods 211 (1983) 525-528

ANGULAR DISTRIBUTION OF ELECTRONS AND X-RAYS FROM HIGH-ENERGY ION-ATOM COLLISIONS

D. Berényi

Proc. Int. Conf. X-Ray and Atomic Inner-Shell Physics, Oregon, 1982, p. 158

INVESTIGATIONS IN ATOMIC PHYSICS BY HEAVY ION PROJECTILES

D. Berényi

Invited talk at the Int. School-Seminar on Heavy Ion Phys., Alushta, Crimea, USSR 14-21 April, 1983.

ELASTIC SCATTERING OF ELECTRONS ON He, Ne, Ar IN THE IMPACT ENERGY REGION FROM 1000 to 3000 eV

J. Herbák, Á. Kövér, E. Szmola, D. Berényi and I. Cserny

Submitted to the Acta Phys. Hung.

BINARY ENCOUNTER APPROXIMATIONS WITH SCREENING TO DDCS OF ELECTRONS FROM ATOMIC COLLISIONS

G. Hock

Proc. Int. Conf. Phys. of Electronic and Atomic Collision, Berlin, 1983, p.637

A STUDY OF AUGER SPECTRA FROM $Ne^{3+,10+}$, $Ar^{6+,17+}$, (5.6 MeV/amu) Ne COLLISIONS

D. Berényi, G. Hock, I. Kádár, S. Ricz, V.A.Shchegolev[1)], B. Sulik, D. Varga J. Végh

1) Joint Institute of Nuclear Research, Dubna, USSR

Proc. Int. Conf. Phys. Electronic and Atomic Collision, Berlin, 1983, p.390

A STUDY OF THE ANGULAR DISTRIBUTION OF THE ELECTRONS IN THE PEAK NEAR $v_e=v_i$ IN THE ELECTRON SPECTRA FROM $H^+$ -Ar and $H_2^+$ -Ar COLLISIONS

Á. Kövér, D. Varga, Gy. Szabó, D. Berényi, I. Kádár, S. Ricz, J. Végh, G. Hock

Journal of Physics B: B16 (1983) 1017 p.

INVESTIGATION OF ELECTRON SPECTRA FROM $Ne^{n+}$+Ne COLLISIONS

D. Varga, J. Végh, I. Kádár, V.N. Melnyikov[1], S. Ricz, B. Sulik, V.A. Shchegoljev[1], D. Berényi, Á. Kövér, I. Cserny

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Proc. Meeting on Experimental Facilities and the First Line Physical Programs on them Dresden 30 Sept - 4 Oct 1982

STUDY OF Ne AUGER SPECTRA FROM ION-ATOM COLLISIONS INDUCED BY 5.6 MeV/amu Ne AND Ar PROJECTILES

D. Varga, J. Végh, I. Kádár, S. Ricz, B. Sulik, V.A Shchegoljev[1], D. Berényi

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Proc. Int. School-Seminar on Heavy Ion Physics. Alusta, Crimea, April 14-21, 1983.

# ANALYTICAL APPLICATIONS

(APPLICATION OF ATOMIC AND NUCLEAR
ANALYTICAL METHODS IN INDUSTRY,
AGRICULTURE, MEDICINE, BIOLOGY ETC.)

MICRONUTRIENT CONTENT OF SOME CEREALS AND CEREAL PRODUCTS

A. Szalay and A. Murányi

Acta Alimentaria, 11 (1982) p. 351

Results of a detailed microanalytical study are presented here, which might contribute data to a reliable assay of the changing micronutrient balance of human diet. The Mn, Cu and Zn content of wheat, rye, rice further of various wheat milling products and bakery products are investigated. With progressive refinement and decreasing ash content the Mn, Cu and Zn content is very significantly decreasing.

The contribution of cereal products to the Mn, Cu and Zn supply of human diet is very significant. In the affluent countries the cereal consumption decreases and the refinement of cereal products improves. As a consequence of these changes the Mn and Cu supply decreases. Zn is replenished by increasing consumption of meat and dairy products.

THE AVERAGE INTAKE OF Cu, Mn AND Zn MICRONUTRIENTS OF THE POPULATION OF HUNGARY IN 1978

A. Murányi-Szeleczky

Acta Alimentaria, 12 (1983) p. 223

The aim of this study was to estimate the average daily dietary intake of the Hungarian population of Mn, Cu and Zn micronutrients. Practically at important components of the diet of the population have been analyzed partly in an earlier work of the author, partly in this work. Statistical data of the Central Statistical Office of Hungary about the annual consumption of various food components were utilized in the estimation of the micronutrient intake. The separated data of the Statistical Office for physical workers and for the intellectuals enabled to estimate the intake of the two classes separately, however the differences in the micronutrient intake were modest. The daily intake is about 11 mg Zn per day per person and this amount seems to be sufficient as the assumed requirement from Zn is between 10-15 mg per day per person. The situation is less favourable in the case of Cu, the intake of which amounts to 1.1 mg per day per person which seems to be marginal according to international recommendations. The intake of Mn amounts to less than 3 mg per day per person which seems to be again just on the margin of the recommended requirement.

The decreased intake of Cu and Mn is attributed to the decreased consumption of cereals and particularly the increased degree of refinement of cereal products as refined cereal products (white flour) contain much less micronutrients than whole grain wheat bread or brown sorts of bread.

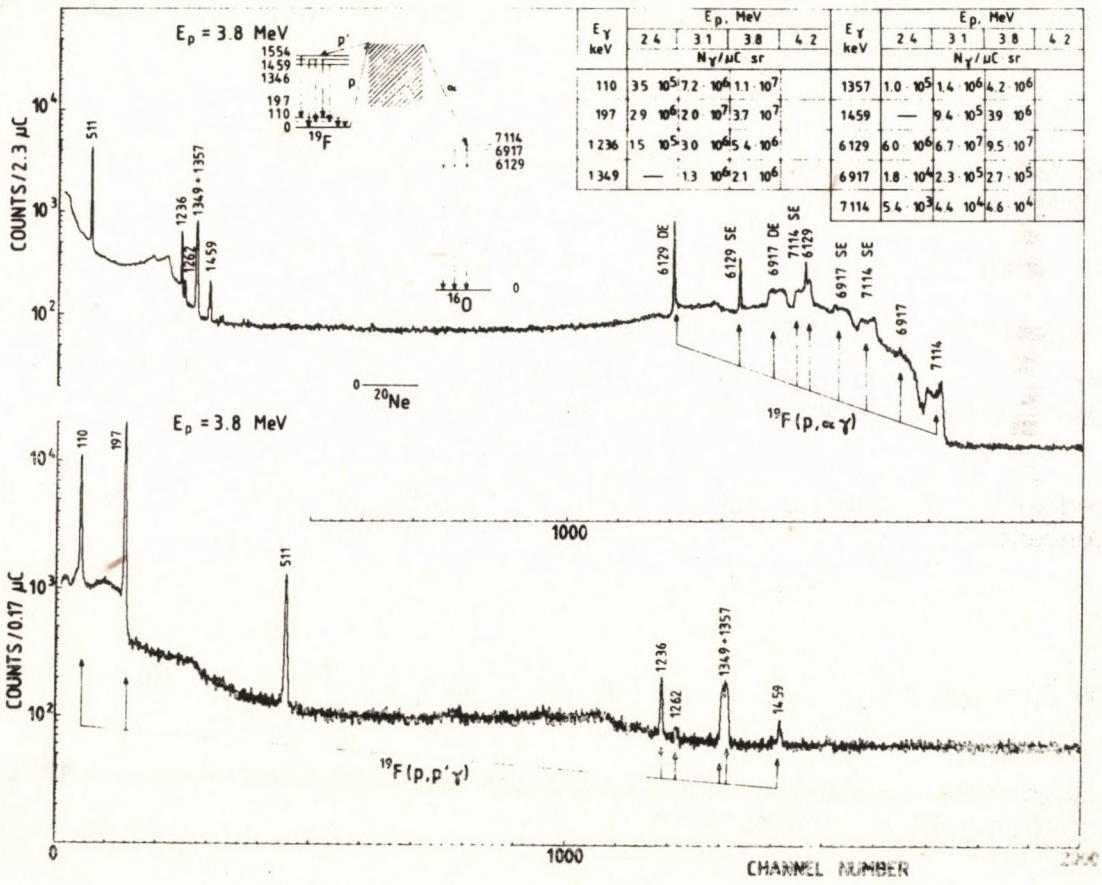
# MEASUREMENTS OF RELATIVE THICK TARGET YIELDS FOR PIGE ANALYSIS ON LIGHT ELEMENTS IN THE PROTON ENERGY INTERVAL 2.4 - 4.2 MeV

Á.Z. Kiss, E. Koltay, B. Nyakó, E. Somorjai, A. Anttila[1], J. Räisänen[1]

1) Department of Physics, University of Helsinki, SF-00170 Helsinki 17, Finland

Submitted to: Journal of Radioanalytical Chemistry

In order to extend the energy range of the systematic investigation on relative thick target yields performed by Anttila et al [2] for $1 \leq E_p \leq 2.4$MeV bombarding energies gamma spectra and yield data are presented for elements Z=3-9, 11-17, 19-21 in the energy range $2.4 \leq E_p \leq 4.2$MeV and the results are discussed from the point of view of PIGE analysis.




| $E_\gamma$ keV | $E_p$, MeV 2.4 | 3.1 | 3.8 | 4.2 |
|---|---|---|---|---|
| | $N_\gamma$/μC sr | | | |
| 110 | $3.5 \cdot 10^5$ | $7.2 \cdot 10^6$ | $1.1 \cdot 10^7$ | |
| 197 | $2.9 \cdot 10^6$ | $2.0 \cdot 10^7$ | $3.7 \cdot 10^7$ | |
| 1236 | $1.5 \cdot 10^5$ | $3.0 \cdot 10^6$ | $5.4 \cdot 10^6$ | |
| 1349 | — | $1.3 \cdot 10^6$ | $2.1 \cdot 10^6$ | |
| 1357 | $1.0 \cdot 10^5$ | $1.4 \cdot 10^6$ | $4.2 \cdot 10^6$ | |
| 1459 | — | $9.4 \cdot 10^5$ | $3.9 \cdot 10^6$ | |
| 6129 | $6.0 \cdot 10^6$ | $6.7 \cdot 10^7$ | $9.5 \cdot 10^7$ | |
| 6917 | $1.8 \cdot 10^4$ | $2.3 \cdot 10^5$ | $2.7 \cdot 10^5$ | |
| 7114 | $5.4 \cdot 10^3$ | $4.4 \cdot 10^4$ | $4.6 \cdot 10^4$ | |

DETERMINATION OF TRACE AND BULK ELEMENTS IN PLASMA AND ERYTHROCYTES OF HEALTHY AND DIABETIC PREGNANTS BY PIXE METHOD

S. Gödény[1], I. Borbély-Kiss, E. Koltay, S. László and Gy. Szabó

1) Department of Obstetrics and Gynecology, University Medical School of Debrecen

Submitted to: International Journal of Gynaecology and Obstetrics

PIXE analysis of blood samples from healthy and diabetic pregnant women was carried out. Eleven elements were detected, S, Ca, P, K, Cl, Fe, Zn, Cu, Rb and Br in red blood cells, S, Ca, P, K, Cl, Fe, Zn, Cu, Ni, Br in the plasma. The concentrations of P, S, Ni, Cu were higher, while those of K, Fe, and Zn were lower in diabetic plasma than in controls. Significantly higher concentrations were measured for P, S, Cl, Fe, Zn, and Rb diabetic erythrocytes compared to normals. Statistical evaluation of the results also indicated significant alteration in the changes of concentrations throughout the pregnancy. Diabetes also resulted changes in most of the correlation between the concentrations of elements observed in normal pregnancy.

PIXE-ANALYSIS OF HUMAN RED BLOOD CELL AND BLOOD PLASMA SAMPLES TAKEN FROM PREGNANT WOMEN

I. B. Kiss, E. Koltay, S. László, Gy. Szabó, S. Gödény[1]

[1]Department of Obstetrics and Gynecology, Medical School Debrecen, Hungary

Meeting on Nuclear Analytical Methods 1983 11-15 April, Dresden, GDR
Submitted to: Journal of Radioanalytical Chemistry

PIXE Multielemental analysis was carried out on human blood plasma and red blood cell samples taken from diabetic and non diabetic pregnant women. Cencentration data of the elements were statisticaly evaluated.

ON SOME EVALUATIONAL PROBLEMS CONNECTED WITH SPECTRA MEASURED BY PIXE

L. Zolnai

Seminar talk at the Inst. für Kernphysik der J.W. Goethe Universität, Frankfurt/Main, 7th Nov, 1983

MASS CALIBRATION OF PIXE-SET-UP IN ATOMKI

I. Fórizs

Diploma thesis, Kossuth University, 1983

(In Hungarian)

PIXE-ANALYSIS OF HUMAN RED BLOOD CELL AND BLOOD PLASMA SAMPLES TAKEN FROM PREGNANT WOMEN

I.B. Kiss, E. Koltay, S. László, Gy. Szabó, S. Gödény[1)]

1) Department of Obstetrics and Gynecology, Medical School Debrecen, Hungary

Meeting on Nuclear Analytical Methods 1983 11-15 April, Dresden, GDR

PIXE Multielemental analysis was carried out on human blood plasma and red blood cell samples taken from diabetic and non diabetic pregnant women. Concentration data of the elements were statisticaly evaluated.

TRACE ELEMENT ANALYSIS OF BIOLOGICAL SAMPLES IN CHARGED PARTICLE INDUCED X-RAY EMISSION PROCESS

I. Kiss, E. Koltay, Gy. Szabó, L. Zolnai, S. Gődény[1)], É. Pintye[2)], S. László[3)]

1) Department of Obstetrics and Gynecology, University Medical School Debrecen
2) Department of Radiation Therapy, Medical University Debrecen
3) Institute for Atmospheric Physics, Budapest

ATOMKI Report X/6 (1983) p. 217.

Proton induced X-ray emission can be used in a broad range of multi-elemental analysis of biological samples. In the present paper two examples are given on its application into medical research. Blood plasma and erythrocyte samples are analysed in order to follow the changes in the concentrations of elemental constituents during pregnancy and radiotherapeutic gamma irradiation.

ELEMENTAL ANALYSIS OF BIOLOGICAL MATERIALS RELATED TO MEDICAL RESEARCH (PIXE ACTIVITIES IN ATOMKI, DEBRECEN, HUNGARY)

I. Kiss, E. Koltay, Gy. Szabó, S. Gődény[1)], É. Pintye[2)], S. László[3)]

1) Department of Obstetrics and Gynecology, University Medical School Debrecen
2) Department of Radiation Therapy, Medical University Debrecen
3) Institute for Atmospheric Physics, Budapest

Seminar at the Atomic Energy Centre, Dhaka, Bangladesh, 1983

MASS CALIBRATION, PROBLEMS OF THE BACKGROUND AND DEAD TIME OF PIXE-METHOD

L. Bartha, I. Kiss, E. Koltay, Gy. Szabó, S. László[1)], I. Fórizs[2)]

1) Institute for Atmospheric Physics, Budapest
2) Kossuth Lajos University, Debrecen

Proc. 26th Hungarian Annual Conference on Spectral Analysis, Kecskemét, 1983, p. 279

LONG-TERM STUDY OF Ca-LEVEL IN BEARD SAMPLES

J. Bacsó

Submitted to: Meeting of Nuclear Analytical Method 1983 11 to 15 April Dresden, GDR.

The Ca-level was measured in the beard shaved daily in term of seven years. The Ca-level has variations of long-term and short-term periods. The short-term period is believed to be caused by daily nutrition, while the long-term period is caused by other, unknown physiological factors, affecting the Ca-metabolism of the system.

It is established that the low Ca level, similar to that of patients suffered from heart attack, may increase to the Ca-level of individuals without complaints. Studying the reasons of Ca-level variations in beard is continued.

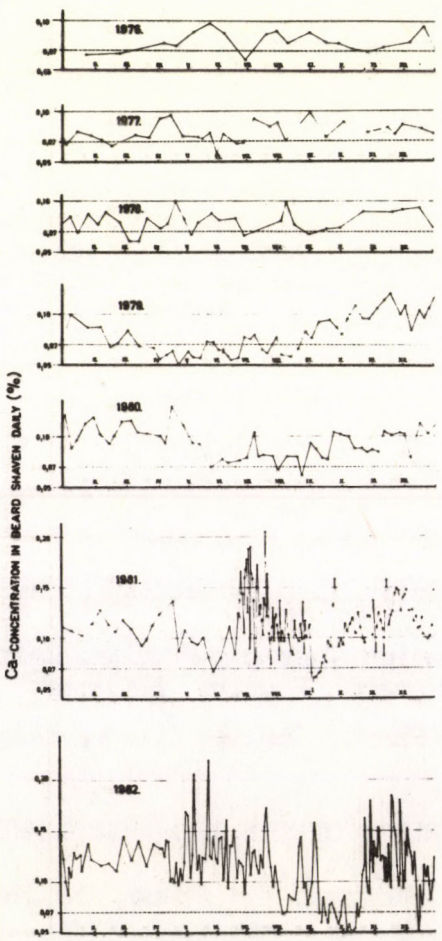



Fig. Diagram of Ca-concentration in beard shaven day by day versus the time

## THE APPLICATION OF XRF IN ENVIRONMENTAL PROTECTIVE MEASUREMENTS

J. Bacsó

Workshop on semiconductor detectors, Dubna, Oct. 4-6, 1983

Ischaemic heart diseases are widespread in all civilized communities of our age. To date it is not clear whether eating customs, style of life, environmental pollution or other ambient damages are the primary causes of these diseases.

It has been established that the Ca-level in hair of patients having suffered ischaemic heart diseases is about five times less than that of healthy individuals. Moreover, recently it has been observed that the adult people of some communities (Hungarian, Japanese) can be divided into two groups according to Ca-level of their hair. The Ca-level of one group is equal to that of patients with heart diseases, while the Ca-level of the other group was that of the healthy population.

It can be assumed that there is a close connection of this distribution with the Ca-metabolism of all adult individuals (above 20 years).

As a long-term measurement we have investigated the variation of Ca-level in daily shaved beards. The Ca-level in beard hair varies in time. The variations have dual character.

There exists a short term variation (one day or shorter); this may be in connection with daily food intake. The other variation shows a slow tendency. These long-term variations are presumed to be connected with regulated physiological processes of the human system or external stress effects. Studies are being undertaken to clarify these observations.

If it proved to be true that external stress effects play a determinative role in decreasing the Ca-level in beard hair, then stress can be considered a very harmful influence in modern life.

The investigation of Ca-level in beard hair was carried out by means of XRF method.

## INVESTIGATION OF CHANGE OF MINERAL METABOLISM OF COSMONAUTS BY X-RAY FLUORESCENCE METHOD

J. Bacsó, M. Kis-Varga, P. Kovács, J. Pálvölgyi, D. Berényi, J. Hideg[1)], R. A. Tigranjan[2)] and T. A. Viting[2)]

[1)]Medical Service of the Hungarian Peoples Army, Budapest, Hungary

[2)]Institute for Medical Biological Problems of the Ministry of Health, Moscow, USSR

Acta Phys. Hung. 53 (1982) 159

Micro-element determination was carried out in the blood serum and in the hair samples of the first Soviet-Hungarian space team, by using the techniques of X-ray fluorescence analysis. The concentration of Cl, K, Ca, Br, Cu and Zn was determined before and after the space flight.

INTERDISCIPLINARY APPLICATION OF X-RAY FLUORESCENCE (XRF)

J. Bacsó

Seminar at the Ho Si Min Pedagogical High School, Eger, 1st March, 1983

RESULTS OF XRF ANALYSES OF ARCHEOLOGICAL GOLD-, SILVER- AND COPPER ALLOYS

L. Költő[1)], M. Kis-Varga

1)Somogy Megyei Muzeumok Igazgatósága, Kaposvár

Seminar at the Veszprémi Akadémiai Bizottság Veszprém, 1983. nov. 2-3.

SHORT TERM AND LONG TERM VARIATIONS OF CA-CONCENTRATION IN BEARD

J. Bacsó

Submitted to the J. Radioanalytical Chemistry

X-RAY EMISSION ANALYSIS OF LATE AVAR BRONZE OBJECTS

L. Koltő[1)], M. Kis-Varga

1) Somogy Megyei Muzeumok Igazgatósága, Kaposvár

Proc. 26th Hungarian Annual Conference on Spectral Analysis, Kecskemét, 1983, p. 279

INVESTIGATION ON THE ACCUMULATION OF LEAD AND OTHER METALS IN PLANTS CAUSED BY MOTOR-TRAFFIC AND METAL MELTING

J. Bacsó, M. Kis-Varga, P. Kovács, G. Kalinka

Submitted to: J. Radioanal. Chem.

The Pb and Br content of plants growing along roads has been determined. It has been stated that the Pb-content of rye grass is proportional with the level of public road traffic. The Pb-content of plants cannot be removed by washing. The Pb, Cu and Zn-concentration of plants grown in the vicinity of a melting works may reach the 10-1000 times value of the normal level.

XPS INVESTIGATION OF STAINLESS STEEL SURFACES HEATED IN AQUEOUS MEDIA

L. Kövér, I. Kádár, I. Cserny, J. Tóth

Vacuum, 33 (1983) p. 99

INVESTIGATION OF SURFACE LAYERS OF STAINLESS STEEL SAMPLES USING XPS METHOD

I. Kádár, L. Kövér, I. Cserny, J. Tóth

Submitted to: Korróziós Figyelő

SURFACE STUDIES OF THE INITIAL OXIDE GROWTH ON NICKEL-RICH ALLOYS

T.C. Chan[1], L. Kövér, N.S. McIntyre[1]

1) Surface Science Western University of Western Ontario London, Ontario N6A 3KT Canada

Symposium on the interaction of electrons, ions and photons with solid surfaces Schenectady (New York), October 26-28, 1983 (USA)

FAST DETERMINATION OF CALCIUM OXIDE IN BAUXITE

I. Kádár, D. Berényi, G. Mórik, D. Varga, E. Vatai, I. Somosi[1], J. Vitéz[1]

[1]Ajka Alumina and Aluminium Works, Ajka (Hungary)

Journal of Radioanalytical Chemistry, Vol. 75 (1982) 153-161

An equipment and procedure were developed to determine the CaO content of bauxite by X-ray fluorescence method using scintillation techniques and a tritium/Ti exciting source. The time needed for the whole samples preparation procedure and measurement is less than 10 min. The range of concentration where analysis is feasible by the equipment, is from 0.3% upwards.

STUDY OF BORON TRANSPORT IN PLANTS WITH A MICRORADIOGRAPHIC METHOD

T. Varró[1], G. Somogyi, M. Najzer[2], I. Mádi[1]

1) Isotope Laboratory, L. Kossuth University, Debrecen, Hungary
2) Josef Stefan Institute, Ljubljana, Yugoslavia

Isotopenparxis, 18 (1982)p 418

The process of passive transport of borate and tetraborate ions was studied in the root of carrot and in the tuber of potato with a quantitative microradiographic method. The boron concentration profiles developing within the plants were determined after various diffusion times, by utilization of the $^{10}B(n,\alpha)^{7}Li$ nuclear reaction. A polycarbonate nuclear track detector registered the $^{7}Li$ nuclei and the alpha-particles. The differential equation of linear diffusion combined with convection was used to describe the concentration profiles within the plants. The diffusion coefficients were determined by means of a computer programme.

STUDY OF THE POSSIBILITY OF NITROGEN MAPPING BY CR-39 TRACK DETECTORS

G. Somogyi, Zs. Varga, and K. Freyer[1], Ch. Treutler[1]

1) Central Institute of Isotope and Radiation Research, Leipzig, GDR

Proc. Int. Symp. on Autoradiography, Tábor, 1983, p. 48

Sensitivity of different CR-39 homopolymers to proton track detection has been studied. The possibility of using these detectors for nitrogen distribution measurement via $^{14}N(n,p)^{14}C$ reaction is discussed. We have studied the variation of background track density induced in the detector material itself by different monoenergetic neutron beams selected by a crystal spectrometer from a thermal neutron spectrum. We have also analysed the background track due to proton recoils produced by the fast neutron component in reactor neutron spectra and the (n,p) reaction taking place on the chlorine contamination of CR-39 sheets. Calibration measurements with solid nitrogen-containing samples are presented.

SEARCH FOR OPTIMUM PARAMETERS OF CPAA MEASUREMENTS

I. Mahunka, S. Takács, J. Dahlbacka[1]

1) Dep. of Phys., Åbo Akademi, Finland

Meeting on Nuclear Analytical Methods 1983 Dresden, 11-15 April, 1983

TRACE ELEMENT ANALYSIS IN HIGH PURITY ALUMINIUM BY CPAA

S. Takács, I. Mahunka, M. Miskei[1] and Z. Horváth[1]

1) ALUTERV-FKI, Budapest

Meeting on Nuclear Analytical Methods 1983, Dresden 11-15, April, 1983

ANALYTICAL INVESTIGATION BY PIXE METHOD

F. Ditrói

Diploma thesis, Kossuth University, 1983

(In Hungarian)

INDUSTRIAL APPLICATION OF CYCLOTRONS FOR ANALYTICAL PURPOSES

S. Takács, I. Mahunka, Z. Horváth[1]

1) ALUTERV-FKI, Budapest

Submitted to: Fizikai Szemle

MASS SPECTROMETRIC DETERMINATION OF NH3 IN FERMENTATION BROTH

G. Langer, Gy. Sántha, S. Bohatka, J. Szilágyi

3rd Symposium of Socialist Countries on Biotechnology, April 25-29, 1983, Bratislava. Abstr. A4-33.

MEASUREMENT OF PROPANOL DURING ERYTHROMYCIN FERMENTATION

J. Szilágyi, S. Bohátka, G. Langer, Gy. Sántha

3rd Symposium of Socialist Countries on Biotechnology, April 25-29, 1983, Bratislava. Abstr. A4-55.

APPLICATIONS OF A CYCLOTRON IN AGRICULTURE

P. Bornemisza

Fizikai Szemle 32 (1982) p. 427

# EARTH SCIENCES AND ENVIRONMENTAL RESEARCH

GAS CARRIER AND DEGASSED MAGMATIC ROCKS AND THE PRIMORDIAL ATMOSPHERE

A. Szalay

Acta Physica Academiae Scientiarum Hungaricae, 53 (1-2), pp. 291-298 (1982)

The gas contents of granites and other continental plutonic rock samples were investigated and compared with a number of mantle rock samples and paricularly with samples of the ophiolite sequence of the Troodos massif (Cyprus). The total volatile loss at 1000 C was investigeted. The gas composition was analysed by means of a quadrupole mass spectrometer after releasing the gases by crushing the samples in high vacuum at room temperature. In further experiments, release of $CO_2$ and volatile loss were determined as a function of temperature be means of derivatography. The high (about 9-15%) $H_2O$ and gas content of many mantle samples is compared to the always lower (1-2%) volatile content of crustal samples which seem to have been at least partially degassed in the course of geological evolution of the Earth's crust. It is assumed that the primordial atmoshphere originated in the degassing of the crust. Gas carrier magmatic rocks in the deeper layers of the Earth, in the mantle still contain the components of the primordial atmosphere. Some of them are accessible and were analysed in this work.

INFORMATIONS SUGGESTING A THERMAL CATASTROPHE IN THE EARLIEST PERIOD OF THE EARTH REVEALED BY THE VOLATILE CONTENT OF IGNEOUS CRUSTAL AND MANTLE ROCKS

A. Szalay

Submitted to the Acta Physica Academiae Scientiarum Hungaricae

THE DEGASSED CONTINENTAL CRUST, EVIDENCE FOR A TRANSIENT THERMAL EVENT IN THE SOLAR-TERRESTRIAL SYSTEM

A. Szalay

Submitted to the Nature

ANTHROPOGENIC $^{14}C$ EXCESS IN THE TROPOSPHERE BETWEEN 1951 AND 1978 MEASURED IN TREE RINGS

E. Hertelendi, E. Csongor

Radiochem. Radioanal. Letters 56 (2) 103-110 (1982)

Measurements were carried out to determine the $^{14}C$ excess in the troposphere between 1951 and 1978 by the analysis of tree rings. Sample preparation and chemical pretreatment of the sample to get the α-cellulose component of the tree rings are described. The excess $^{14}C$ activity was measured by proportional counter. The results prove the presence and the variations of anthropogenic influences in the tropospheric $^{14}C$ concentration.

$^{14}C$ DATING IN ARCHAEOLOGY, ABSOLUTE CHRONOLOGY

E. Csongor

Symposium on the 25th Anniversary of the Institute of Archaeology of the Hungarian Academy of Sciences, - Budapest, 24-26. Oct. 1983

$^{14}C$ -DATING

E. Csongor

Submitted to: Veszprém megyei Muzeumi Közlemények

PHASES OF BLOWN-SAND MOVEMENTS IN THE NORTH-EAST PART OF THE GREAT HUNGARIAN PLAIN

Z. Borsy[1)], E. Csongor, S. Sárkány[2)], J. Szabó

1) Institute of Geography, Kossuth Univ., Debrecen
2) Department of Plant Anatomy, Eötvös Univ., Budapest

Acta Geographica Debrecina 20 (1981) p. 5

EXAMINATION OF THE BED OF THE KARCSA BROOK WITH POLLEN ANALYTICAL AND RADIOCARBON METHODS

E. Csongor, E. Félegyházi[1)], I. Szabó

1) Institute of Geography, Kossuth Univ., Debrecen

Acta Geographica Debrecina 20 (1981) p. 51

K-Ar DATING FOR GABBROS AND GRANODIORITES, UMM-RUS, EASTERN DESERT, EGYPT

O.A. Kamel[1)], A. El Bakri[1)], M. El Mahallawi[1)], K. Balogh, E. Árva-Sós

1) El Minia University, Egypt

5th Int. Cong. on Basement Tectonics, Cairo 16-20, Oct 1983

RADIOMETRIC DATA FROM THE EOCENE/OLIGOCENE BOUNDARY STRATOTYPE IN HUNGARY

K. Balogh

Workshop on Terminal Eocene Events, Visegrád, March 27 - April 1, 1983

K/Ar DATES FROM THE EOCENE/OLIGOCENE BOUNDARY STRATOTYPES IN HUNGARY

K. Balogh

Submitted to: Őslénytani Viták
(In Hungarian)

# XPS INVESTIGATION OF AIR POLLUTION EJECTED BY A COAL-FIRED POWER PLANT

L. Kövér and J. Tóth

Submitted to: Atmospheric Environment

A method for sampling and investigating the aerosol particulates and gaseous pollutants of the air is described. The pollutants were collected on silver (Ag), copper (Cu) and graphite surfaces placed in the neighbourhood of a coal-fired power plant. The study of the composition of the aerosol and gaseous pollutants was carried out by means of XPS method, as a function of the distance from the power plant.

The aerosol particulates ( 1 μm in diameter) were sticked on the surface of the samples mentioned above, but they did not form an unbroken layer on them, that is why we were able to assign not only the components of the aerosol particulates, but the gaseous pollutants of the air on the basis of their chemical reactions with the sample material measuring the photoelectron lines of the samples material of its own as well.

We could assign the photoelectron lines of different types of air pollutants (S, N, Cl, F, Mg, Al, Si, Na, I, C).

The main pollutant was the sulfur. The sulfur could be found at every sampling place and on every sample surface. Far from the centre of the power plant the sulfur was mainly in sulphate form.

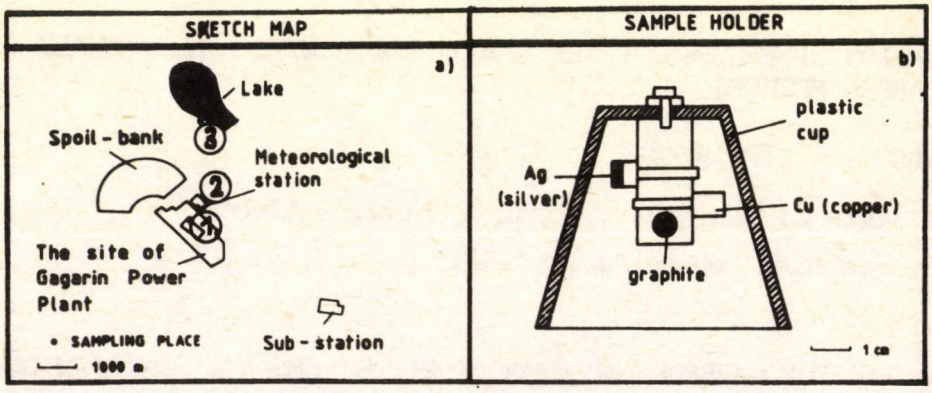



Fig. 1.

a. The scheme of the map which shows the sampling places in the environment of the Gagarin Powerplant in Hungary. The sampling points: 1,2,3.
b. The sample holder was a plastic cup opened towards the ground, so the fine particulates of the air can reach indirect way onto the sample surface.

## STUDY OF ALPHA-ACTIVITY DISTRIBUTIONS IN ENVIRONMENTAL SAMPLES BY CR-39 TRACK DETECTORS

I. Hunyadi, G. Somogyi, S. Szilágyi

Proc. 13th International Symposium on Autoradiography, Tábor (CSSR) 3-5 May 1983. p. 210

The unique sensitivity of CR-39 nuclear track detectors to high-energy nuclear particles opens several new fields for the application of autoradiographic methods. A field, which recently has become of public interest, is the mapping of low-level alpha-activity distributions in different environmental samples. Moreover the CR-39 detector can also provide possibilities for the identification of various radioactive elements. We present three such methods based on the following procedures: i/ Comparison of track numbers in pointlike track clusters found in connected alpha and fission fragment radiograms, ii/ Analysis of alpha-decay properties by recording autoradiograms in different time periods after the sample collection, iii/ Determination of alpha-particle energies by measuring proper geometrical parameters of individual etch-tracks in autoradiograms. We have applied the above techniques to analyse the alpha-autoradiograms of aerosol, soil and plant samples. It has been found out that majority of long-lasting alpha-activity can be accounted to the presence of $^{210}$Po and its precussor $^{210}$Pb in the environmental samples investigated.

## STUDY OF $^{210}$Po AND $^{210}$Pb DISTRIBUTIONS IN ENVIRONMENTAL SAMPLES BY CR-39 TRACK DETECTOR

I. Hunyadi, G. Somogyi and S. Szilágyi

12th International Conference on SSNTDs, Mexico, Sept 4-10, 1983

In recent years special attention has been devoted to the the analysis of the distribution of low-level alpha-emitting radionuclides in environmental samples. The unique sensitivity of CR-39 track detectors has opened several new possibilities in such investigations. We have analysed the distribution of long-lived alpha-emitters in aerosol, soil and plant samples by autoradiography using CR-39. A study of the alpha-activity attached to aerosols of different particulate sizes separated by a cascade impactor has also been performed. It is found that in the majority of samples the alpha-activity can be dominantly related to the presence of $^{210}$Po produced by its beta-active precursor $^{210}$Pb. To the analysis of the samples we have applied the following methods: 1) Study of the alpha-decay properties by autoradiographs produced at different times after collecting the sample. 2) Analysis of single alpha-tracks or track clusters by a method developed for high-resolution α-spectroscopy. In our method the parameters to be measured are the major axis of surface track opening, the diameter of the etched-out track end, the total length measurable on the surface along the projected track and the thickness of layer etched away from the detector surface.

INTEGRAL MEASUREMENTS OF ALPHA AND GAMMA RADIATION IN DWELLINGS

B. Paripás, G. Somogyi, J. Nikl, S. Takács, G. Rohács

Conference on Radiationbiology and Radiation-Safty, Budapest, Oct. 28, 1983

DETERMINATION OF RADON AND DAUGHTER EXPOSURE IN DWELLINGS WITH SOLID STATE NUCLEAR TRACK DETECTORS

B. Paripás[1], G. Somogyi, S. Takács[1]

1) Borsod-Abauj-Zemplén megyei Közegészségügyi és Járványügyi Állomás, Miskolc

Izotóptechnika 26 (1983) p. 26

RADON MEASUREMENTS IN THE HAJNÓCZY CAVE

G. Somogyi, Zs. Varga, G. Németh[1], J. Pálfalvi[2], J. Gerzson[3]

1) Hajnóczy Gimnázium, Tiszaföldvár
2) MTA KFKI, Budapest
3) Mecseki Ércbányászati Vállalat Kővágószőllős

Izotóptechnika, 26 (1983) p. 38

Rb-Sr ISOTOPIC AGES OF GRANITOID ROCKS IN THE SPIS-GEMER METALLIFEROUS MOUNTAINS, EASTERN-SLOVAKIA

E. Svingor, P. Grecula[1], Á. Kovách

1) Geological Survey, Kosice

Submitted to: Mineralia Slovaca

# DEVELOPMENT OF METHODS AND INSTRUMENTS

# STATUS REPORT ON CYCLOTRON LABORATORY PROJECT

A. Valek and A. Paál

The realisation of the cyclotron project of our institute began in 1978. The construction work of the cyclotron building started in 1982, the concrete shielding walls of basement floor have been built and the laying the foundations in other part of the building are in progress. The transportation and the assembling of the cyclotron, manufactured by the D. Efremov Scientific Researche Institute of Electrophysical Apparatus in Leningrad, is expected in 4th quarters of 1984.

Data acquisition and analysis will be based on a computer network system with a host computer analogous to PDP-11/44 (Fig.1.). Its installation is expected on the first half of 1984. During 1983 the main emphasis has been put on the design of the data acquisition station. Each satellite station consists of a small number of components: a CAMAC crate, a terminal, LSI-11/23 computer including processor, memory, CAMAC crate controller, display board and network interface.

Development of the network software, probably the most complex part of the system, is nearly complete. Nuclear analog signals are digitized with 13 bit ADCs purchased from SILENA. Data from ADCs are stored in a 16K dedicated CAMAC memory. Separately from the high speed data collection it is allowed to the experimenter to start and stop the experiment, or displays of experimental parameters, data, and data histograms for experiment monitoring.

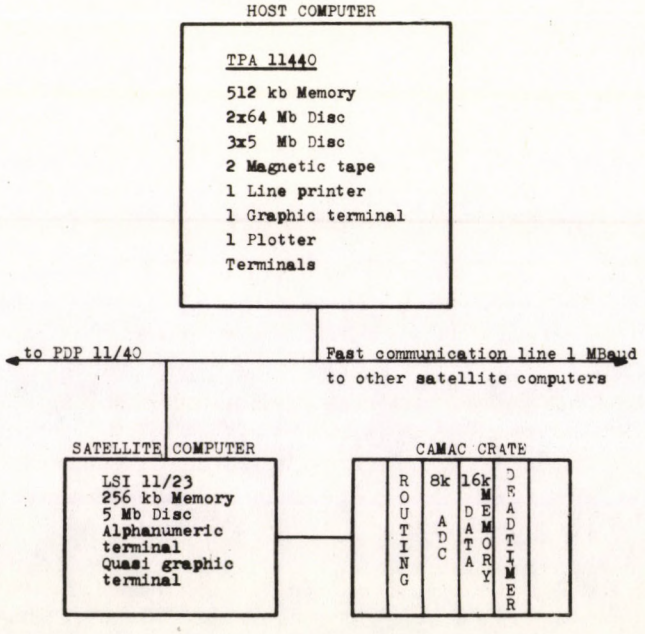



Figure 1. Hardware Layout of the Data Acquisition System

## CYCLOTRON LABORATORY FOR INTERDISCIPLINARY AND APPLIED RESEARCH

A. Valek

Recent Results in Researching Nuclear Energy and Atomic Nuclei, Vol.1. (1983) p.156

In the first part of the paper the planned Cyclotron Laboratory of ATOMKI, equipped with the compact isochronous cyclotron MGC, is described. In the second part a general review is given about the focusing magnetic force acting in the conventional and sector-focusing cyclotrons, and finally, the main magnetic charactheristicts of the cyclotron MGC are shown.

## ON THE PROJECT OF CYCLOTRON LABORATORY IN DEBRECEN

Z. Máté

XXI. Session of the Nuclear Structure Committee of Low Energy Physics Section of Scientific Council of JINR, Dubna, 12-14 April 1983.

The main characteristics of the Debrecen Cyclotron program were briefly reported in the lecture: basic beam parameters of the cyclotron MGC, expenditure and schedule of the investment, lay-out of the laboratory and the plans of use of the cyclotron.

## CALCULATION OF MONOCHROMATIZATION SYSTEM OF THE U-400 CYCLOTRON BEAM

Z. Kormány

Communication of the Joint Institute for Nuclear Research, Dubna, 9-82-829 (1982)

(In Russian)

Monochromatization system of the U-400 cyclotron beam, consisting of two bending magnets with a homogeneous field, is analysed. The first order optical properties of the system are shortly described and the effect of the second order aberrations are examined in order to determine their effect on the system resolution power. The existence of an optimal beam transporting is shown, when the effect of these aberrations in minimal. The achievable resolution depends on the radial beam emittance and the value of the $(y\,y^2)$ aberration coefficient. Due to these calculations a relation is determined between this coefficient and the accuracy of the required magnetic field shaping. The results show that in the case of the field shaping accuracy on the level $\Delta B/B=10^{-4}-10^{-3}$ the system will provide monochromatic beam with $\Delta E/E=4\cdot10^{-4}$ and with the intensity of several percent of the extracted from the cyclotron beam intensity.

The investigation has been performed at the Laboratory of Nuclear Reactions, JINR.

CYCLOTRON LABORATORY PROJECT OF ATOMKI

G. Bibok

Seminar at the Kernfysisch Versneller Instituut der Rijksuniversiteit, Groningen, Dec 5, 1983

REVIEW OF THE APPLICATION POSSIBILITY OF U-103 CYCLOTRON

I. Mahunka

Recent Results in Researching Nuclear Energy and Atomic Nuclei, Vol. 1 (1983) p.183

AGRICULTURAL APPLICATION POSSIBILITIES OF SMALL CYCLOTRONS

I. Mahunka

ATOMKI Riport, X/5 (1983) 204

APPLICATION OF THERMOCROMATOGRAPHY FOR SEPARATION OF ULTRA MICRO-QUANTITY OF ISOTOPE MIXTURES

Z. Kovács

Thesis for the candidate of science degree

CHARACTERISTICS OF MIXED NEUTRON-GAMMA RADIATION FIELDS AROUND CYCLOTRONS

I. Uray, P. Manngård[1)], H.J. Probst[2)], M. Heinzelmann[3)]

1) Institute for Physics, Åbo Akademi Porthansgatan 3, SF-20500 Åbo 5I Finland
2) Institute for Nuclear Physics, Kernforschungsanlage Jülich, W. Germany
3) Department of Safety and Radiation Protection, KFA Jülich, W. Germany

"Recent Developments and New Trends in Radiation Protection" XI. Regional Congress of IRPA, Vienna, September 20-24, 1983

POSSIBLE USE OF LiF DOSIMETERS IN MIXED NEUTRON-GAMMA FIELDS

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1) Institute for Applied Physics, Kossuth L. University, Debrecen, Hungary
2) Institute for Nuclear Physics, Kernforschungsanlage Jülich, W. Germany
3) Department of Safety and Radiation Protection, KFA Jülich, W.Germany

Recent Developments and New Trends in Radiation Protection" XI. Regional Congress of IRPA, Vienna, September 20-24, 1983

ACTIVITY DETERMINATION IN SAMPLES OF ISOTOPE MIXTURES BY USING SUM PEAKS IN Ge(Li) SPECTRA

I. Uray, I. Török, E. Gyarmati

Acta Phys. 52 (1982) p. 469

THE EFFECT OF NEUTRON AND GAMMA IRRADIATION OF PEA SEEDS ON THE DEGRADATIVE INSIME OF SEEDLINGY

Gy. Bagi[1)], E. Hidvégi[1)], P.P. Bornemiszáné, Cs.M. Véghné

1) National Research Institute for Radiobiology and Radiohygenie

ATOMKI Riport X/5 (1983) p.131

MEASUREMENT OF THE RESPIRATION OF SEEDLINGS WITH A QUADRUPOL MASS-SPECTOMETER MASS-SPECTROMETER

P. Szőke[1)], P.P. Bornemiszáné, L.M. Benedekné[1)], P.O. Maulné[1)], K. Kiss, Cs.M. Véghné

1)Department of Botany and Plant Physiology of the University of Acricultural Sciences, Gödöllő

ATOMKI Riport, X/5 (1983) p. 135.

EFFECT OF IRRADIATION ON VARIABILITY IN PRODUCT COMPONENTS OF SOYA BEAN

K. Pásztor[1)], K. Egri[1)], Z. Török[1)], P.P. Bornemiszáné

1) University for Agricultural Sciences, Debrecen

ATOMKI Riport X/5 (1983) p.156

EFFECT OF FAST NEUTRONS ON THE SYMBIOSIS OF RHISOBIUM

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1) Res.Inst. Soil Science and Agricultural Chem. of the Hung. Acad. of Sci.
2) Res.Inst. for Feedstuff Production

ATOMKI Riport X/5 (1983) p. 138

IRRADIATION OF LUPINE (LUPINUS SP.) SEEDS FOR INDUCING MUTATIONS

B.M. Ratkosné[1] , F. Borbély[1)], P.P. Bornemiszáné, Z. Dézsi[2)], J. Nagy[3)] Cs.M. Véghné, K. Kiss

1) Research Institute of Seed Production and Trading Company, Nyiregyháza
2) Clinic of Radiology, Medical University Debrecen
3) University for Agricultural Sciences Debrecen

ATOMKI Riport, X/5 (1983) p.160.

A NEW INVESTIGATION POSSIBILITY IN THE AGRICULTURAL RESEARCH

P.P. Bornemiszáné, I. Buzás[1)]

1) Res.Inst. Soil. Science and Agricultural Chem. of the Hung.Acad.of Sci.

Melioráció és Tápanyaggazdálkodás (1982) p. 73.

STUDIES ON THE INTERNAL GAS COMPOSITION OF THE WHEAT STALK

B. Schlenk, P.P. Bornemiszáné, G. Langer, F. Sági[1)], L. Mózsik[1)]

1) Cereal Research Institute, Szeged

Botanikai Közlemények 69 (1982) p. 271

STUDIES ON THE INTERNAL GAS COMPOSITION IN THE GREEN STALK OF WINTER WHEAT (TRITICUM AESTINUM)

P.P. Bornemiszáné, F. Sági[1)], B. Schlenk, L. Mózsik[1)], G. Langer

1) Cereal Research Institute, Szeged

Submitted to: Botanikai Közlemények

STUDIES ON THE INTERNAL GAS COMPOSITION OF THE WHEAT STALK

P.P. Bornemiszáné, F. Sági[1)], G. Langer, B. Schlenk and L. Mózsik[1)]

1) Cereal Research Institute, Szeged

Submitted to: Wiss. Z. Humbold-Universität zum Berlin

MASS SPECTROMETRIC DETERMINATION OF GASES IN PLANTS

G. Langer, S. Bohátka, B. Schlenk, P.P. Bornemiszáné, I. Buzás[1)], G. Pártai[1)], F. Sági[2)], L. Mózsik[2)]

1) Res.Inst. Soil Science and Agricultural Chem. of the Hung. Acad. of Sci.
2) Cereal Research Institute Szeged

IX. International Vacuum Congress Madrid Sept, 26 - Oct 1 1983

THE WHEAT STALK: STUDIES ON THE INTERNAL GAS COMPOSITION

P. Bornemisza-Pauspertl, G. Langer, B. Schlenk, L. Mózsik[1)], F. Sági[1)]

1) Cereal Research Institute, Szeged

3rd Symposium "Biophysik pflanzlicher Systeme", Thüringen, 1983

INVESTIGATION OF DOSE EFFECT AFTER FAST NEUTRON IRRADIATION OF VEGETABLES SEEDS

I. Csorba[1)], L. Fodor[1)], G. Németh[1)], P.P. Bornemiszáné, K. Kiss, Cs.M. Véghné

1) Research Institute of Seed Production and Trading Company, Szentes

ATOMKI Riport, X/5 (1983) p. 198

SIMPLE METHOD AND EQUIPMENT FOR THE PRECISE INTENSITY MEASUREMENT OF RADIO ISOTOPES

B. Sulik, P.P. Bornemiszáné, S. Fekete, Zs. Kertész

ATOMKI Riport X/5 (1983) 203

# PERFORMANCE AND DEVELOPMENT OF THE 5 MILLION VOLT VAN DE GRAAFF ACCELERATOR

L. Bartha, A.Z. Kiss, E. Koltay, I. Papp, Gy. Szabó

Status report

There has been an increasing demand for the use of the accelerator during 1983. The calculated total time was 2279 hours: of these 2228 hours were used for experiments and 51 hours for machine tests. Table 1. shows the distribution of machine time between different experimental fields. The weight of analytical studies and atomic physics increased further this year.

In 1983 a new species of ion $^3He^+$ was used for the first time in the laboratory for nuclear physical experiments. The distribution of operating time versus ion species is shown in table 2.

In the middle of December the accelerator was stopped for changing the accelerating tube and the belt.

In 1983 development works were mainly limited to the inserting of gas stripper target unit with differential pumping in two different locations of beam transport system near the analysing magnet. Pre-analyser and post--analyser stripers [1] are prepared for regular use in ion-atom collision research.

[1] I. Hunyadi, A.Z. Kiss, I. Kiss, E. Koltay, Gy. Szabó; Nuclear Instruments and Methods, in press.

Table 1.

| Field | hours | % |
|---|---|---|
| Nuclear physics | 505 | 22.2 |
| Atomic physics | 466 | 20.4 |
| Analytical studies | 995 | 43.7 |
| Other experiments | 262 | 11.5 |
| Machine tests | 51 | 2.2 |
| total: | 2279 | 100.0 |

Table 2.

| Species | hours | % |
|---|---|---|
| $H^+$ | 1459 | 65.5 |
| $^3He^+$ | 160 | 7.2 |
| $^4He^+$ | 546 | 24.5 |
| $N^+$ | 63 | 2.8 |

## OPTICAL BEHAVIOUR OF ACCELERATION TUBES STUDIED IN BREMSSTRAHLUNG MEASUREMENTS

A. Z. Kiss, E. Koltay, Gy. Szabó, J. Félszerfalvi

Nuclear Instruments and Methods in Physics Research, 212 (1983) 81-89.

In the case of high voltage accelerators the intensity and the energy distribution of the bremsstrahlung emitted by the acceleration tube is closely related to the construction of the tube. From the point of view of the optimization of the radiation shields to be built up it is of high interest to measure the radiation field as the function of tube construction and working condition of the accelerator. The same data represent an important tool for tube diagnostic. Intensity distributions, maximum and mean x-ray energies were measured around a 5MV Van de Graaff accelerator by the help of NaI(Tl) scintillation detectors and $CaSO_4$: Tm thermo-luminescent dosimeters. The application of inclined tube geometry is highly recommended.

## CHARGE STATE DISTRIBUTION OF LIGHT HEAVY IONS ACCELERATED IN A SINGLE ENDED VAN DE GRAAFF ACCELERATOR

I. Hunyadi, A. Kiss, I. Kiss, E. Koltay and Gy. Szabó

Submitted to: Nuclear Instruments and Methods

Ion-atom collision experiments require in many cases accelerated light heavy ions of various charge states in the energy region of a few MeV. These energies are often too low for tandem accelerators. Therefore, single ended Van de Graaff accelerators normally used for the acceleration of the lightest ions in single charge states find new applications in producing a broader selection of ions for the investigations in atomic physics.

With this end in view Penning ion sources combined with a charge state selector are sometimes used in the terminal of the accelerator. In addition we used stripper targets arranged in different places of the beam transport system.

In this paper charge state spectra obtained from a Penning source of Bethge's type are presented. Also presented are results obtained with strippers on the 5 MV Van de Graaff accelerator of this Institute. The maximum energy of ion beams to be handled with an analysing magnet of given BR value can be enhanced by a stripper near the entrance slits of the analysing magnet. A stripper target situated in a point between analysing and switching magnets help in increasing the intensity of higher charge state components.

The method of solid state track detectors was used for detecting the weakest components.

ELECTRON ACCELERATORS IN THE AGRICULTURE AND FOOD PRODUCTION

E. Koltay

ATOMKI Riport, X/5 (1983) p. 180

HIGH TENSION EQUIPMENT FOR PRACTICAL APPLICATIONS

E. Koltay

Fizikai Szemle 32 (1982) p. 325

DETERMINATION OF NUCLEAR LEVEL LIFETIME ON THE BASIS OF THE LSS ANALYSIS OF DOPPLER BROADENED $\gamma$-LINES

B. Nyakó, Gy. Szabó and Á.Z. Kiss

ATOMKI Report E/1 (1983)

A FORTRAN programme is presented for deducing level lifetimes on the basis of fitting Doppler broadened $\gamma$-lines by using the LSS stopping theory as introduced by Lindhard, Scharff and Schiøtt and modified by Blaugrund.

ANALYSIS OF DOPPLER BROADENED $\gamma$-LINES FOR DETERMINING NUCLEAR LEVEL LIFETIMES; A COMPARISON OF TWO METHODS

M.M. Abdel-Hady, Á.Z. Kiss, E. Koltay, B. Nyakó, Gy. Szabó

ATOMKI Report E/2 (1983) p.207

Results of line shape analyses on the base of Monte Carlo calculation as well as Blaugrund treatment are compared and tested with experimental data from the $^{13}C(p,\gamma)^{14}N$ reaction measurement on different backing materials.

CON - A PROGRAM TO MAKE A FILE CONTINUOUS ON A FILES-11 DISK

G. Székely

Decus Euroscope No 20 (1982)

If a disk does not have enough free contiguous space for a task or another file, the program CON can help the user. CON scans the maps of the logically noncontiguous files on the disk and if it has found a retrieval pointer of a contiguous space not smaller than the given file, it exchanges the appropriate blocks of the two files. Then the file maps are modified and the program sets the flag UC.CON in the header of the input file. The only fatal error return is "NO SUCH LARGE CONTIGUOUS SPACE IN THE MAPS".

PREPARATION OF COUNTING GAS OF PROPORTIONAL COUNTERS FOR RADIOCARBON DATING

E. Csongor, I. Szabó, E. Hertelendi

Radiochem. Radioanal. Letters 55 (1982) p. 303.

Systems for combustion and methane synthesis used for preparing counting gas of proportional counters in radiocarbon dating are described. The purity of $CO_2$ gas is checked by quadrupole mass spectrometer during the purification process after the combustion of the samples.

DEVELOPMENT OF ENERGY DISPERSIVE X-RAY SPECTROMETER AND ITS INTERDISCIPLINARY APPLICATIONS

J. Bacsó

Thesis for the candidate of science degree
(In Hungarian)

ON THE FACTORS DETERMINING THE ENERGY RESOLUTION OF Si(Li) X-RAY SPECTROMETERS

G. Kalinka

Seminar, Institute of Physics of the Acad. of Sci. of Vietnam, Hanoi, 13th Dec. 1983

FABRICATION OF Si(Li) DETECTORS AND CONSTRUCTION OF HIGH RESOLUTION X-RAY SPECTROMETERS

G. Kalinka

Seminar at the Institute of Physics of the Acad. of Sci. of Vietnam, Hanoi, 14th Dec. 1983

INVESTIGATION OF PARAMETERS OF Si(Li) X-RAY SPECTROMETERS AS A FUNCTION OF TEMPERATURE

I. Gerőcs

Diploma thesis, Kossuth University, 1983
(In Hungarian)

CONSTRUCTION OF A I-V PLOTTER FOR THE MEASUREMENT OF Si-Li X-RAY DETECTORS

J. Vámosi

Diploma thesis, Kossuth University, 1983
(In Hungarian)

MEASUREMENT OF FACTORS AFFECTING THE ENERGY RESOLUTION OF X-RAY SPECTROMETERS

G. Kalinka, J. Bacsó

KFKI report No 81-12, p. 10

INVESTIGATION OF Si-Ge ALLOY AND ITS APPLICATION FOR SPECTROMETRY OF HARD X-RAYS

J. Bacsó, G. Kalinka, J. Keleti[1)], N.E. Mazurik[2)], T.I. Pirozhkova[2)], A.K. Pustovoit[2)], N.Ja. Sedov[2)]

1) Institute of Electric Research
2) Leningrad Institute of Nuclear Research, Gatchina

KIJAI-report No 81-12, p. 37

QUADRUPOLE MASS SPECTROMETER ANALYSER SYSTEM FOR MONITORING FERMENTATION PROCESSES

S. Bohátka, K. Pólya[1)], G. Langer, J. Szilágyi[1)]

1) BIOGAL Pharmaceutical Works H-4042 Debrecen, Hungary

Proc. Conf. Advances in Fermentation, London, 1983, p. 131

A quadrupole mass spectrometer system equipped with a sampling unit has been developed for the measurement of gases and volatile components involved in the fermentation processes. The exhaust gases of the fermenters and some components dissolved in the fermentation broth (e.g. $O_2$, $CO_2$, $N_2$, propanol) were analysed online and filtered samples were taken for off-line analysis. The components were measured continuously during during many 168 hour programs and the equipment worked reliably in the semi-industrial environment. These results provided the basis of the development of a complex analyser/control system for laboratory use and industrial process control.

MASS SPECTROMETRIC DETERMINATION OF GASES IN PLANTS

G. Langer, S. Bohátka, I. Berecz, B. Schlenk, P. Bornemisza-Pauspertl, I. Buzás[1)], G. Pártay[1)], F. Sági[2)], L. Mózsik[2)]

[1)]Research Institute Soil Science and Agricultural Chemistry of the Hung. Acad. of Sci. H-1525 Budapest, Pf. 35. Hungary

[2)]Cereal Research Institute, H-6701 Szeged, Pf. 391. Hungary

IX. International Vacuum Congress, Madrid, Sep 26 - Oct 1, 1983

In the research of plant physiology measurement of gasmetabolism plays an important role. Most methods require that plants should be examined isolated from their natural environment. This paper presents a method using a quadrupole mass spectrometer with a membrane sampling unit to directly measure gases in plants in gas-phase or dissolved in the liquids and tissues, without disturbing the metabolism and the environment of the plants. To demonstrate the capabilities of the method the behaviour of the plants was investigated when they were under extreme physical and chemical effects. Finally, some possible further uses are referred to.

## INDUSTRIAL APPLICATION OF MASS SPECTROMETRY TO MONITORING FERMENTATION

J. Szilágyi*, S. Bohátka, G. Langer, Gy. Sántha*, P. Seres*

* BIOGAL Pharmaceutical Works, H 4042 Debrecen, Hungary

Submitted to:
Third European Congress on Biotechnology, München, 10-14 September 1984.

A measuring and controlling system has been developed in the pilot plant of the BIOGAL Pharmaceutical Works. One essential part of this system is a quadrupole mass spectrometer (QMS). (S. Bohátka, K. Pólya, G. Langer, J. Szilágyi: 1983, Advances in Fermentation, London)
The QMS system has operated excellently in industrial circumstances, during several long term fermentation processes. High correlation was found between the values of QMS and traditional sensors. (i.e. dissolved oxygen, $O_2$ and $CO_2$ content in the exhaust gases, $NH_3$ content in the fermentation broth)
Following up the dissolved $CO_2$ content of the fermentation broth we received important data in the experiments made for improving the yield of fermentation.
Our experiences were important - among others - in OTC fermentation. First we examined the solubility of $CO_2$ in the function of pH. Then we made paralell fermentations where the dissolved $CO_2$ were controlled at different levels by changing the air ration, pH and the $CO_2$ content of the inlet air. The dissolved $CO_2$ concentration has a significant effect on the process of OTC fermentation.

## MASS SPECTROMETRIC MONITORING OF FERMENTATION PROCESSES

S. Bohátka, G. Langer, J. Szilágyi[1)], I. Berecz, Z. Diós and L. Kiss

[1)]BIOGAL Pharmacentical Works, H-4042 Debrecen, Hungary

IX. International Vacuum Congress, Madrid, 26 Sep - 1 Oct, 1983

A quadrupole mass spectrometer system was constructed for the better understanding of the fermentation processes and for the control of industrial fermentations. The exit gas of the fermenters and dissolved gases, volatile compounds in the fermentation broth are analysed.

The sampling unit has 1-6 probes and can take 1-6 different samples fast enough compared with the time constant of the biological processes and the large volumes of the fermenters. The probes made of stainless steel tubing and silicon rubber membrane worked well during many 168 hour programs.
An additional fast gas sampling unit is also supplied. Response time: 50 ms. The analyser is a microprocessor controlled quadrupole mass spectrometer of 1-300 amu mass range. Mass spectrum registration and single ion monitoring are available.

Measurements were carried out in laboratory and semiindustrial scale, on 14 l, 60 l and 1500 l fermenters. $O_2$, $N_2$, $CO_2$ and propanol were detected in the gas and liquid phase on-line, ammonia and other components requireing pH-adjustment were analysed off-line.

## PEAK SELECTOR FOR QUADRUPOLE MASS SPECTROMETER

I. Berecz, S. Bohátka, Z. Diós and G. Langer

Vacuum 33, (1983) p. 87

A modern construction peak selector based on digital techniques has been constructed. The instrument can be extended to a maximum of nine signal channels selecting the ion-current with the help of thumbwhell switches. In the first channel it is possible to set the full mass range, while in each one of the other eight channels a width of a maximum of nine atomic mass units can be set. The instrument has got a mass identifier circuit and optionally each channel has a fast analog signal processing unit. The peak selector can be coupled to any kind of quadrupole mass spectrometer with a maximum mass range up to 512 amu.

## QUADRUPOLE MASS SPECTROMETER COUPLED TO DERIVATOGRAPH

I. Berecz, S. Bohátka, G. Langer and G. Szöőr[1)]

1) L. Kossuth University Institute of Mineralogy and Geology, H-4010 Debrecen, Hungary

International Journal of Mass Spectrometry and Ion Physics, 47 (1983) p.273

A comtination of a thermoanalytical device (Derivatograph) and a quadrupole mass spectrometer is presented. The samples are placed in the furnace of the derivatograph and heated according to a preselected program. The mass and temperature variations of the samples are measured precisely in the derivatograph and the gaseous products are analysed by the quadrupole after a two-step pressure reduction. This combination was tested with measurements on carbonates, sulphates simple salts (compounds and minerals a like), rock and fossil samples containing organic matter. The quadrupole enhances the sensitivity of the derivatograph and explains many details of sample behaviour not revealed by a simple derivatograph. Some examples of the combined analyses are shown.

## A SMALL UNIVERSAL QUADRUPOLE MASS SPECTROMETER

I. Berecz, S. Bohátka, J. Gál, L. Kiss, G. Langer, A. Paál and R.M. Kovács

Vacuum 33, (1983) p. 69.

A universal quadrupole mass spectrometer (type Q60U) has been constructed for general laboratory and industrial purposes. Its 10 cm long analyser rod system, 1-60 amu mass range and $4 \cdot 10^{-4}$ A $mbar^{-1}$ sensitivity make it a good residual gas analyser. Due to its high mass resolution it can be used also as an analytical instrument. It works as a total pressure gauge, too, saving the const of a vacuum gauge. The bias and gain controls and audio-frequency signal generator of its leak detection unit complete the quadrupole as a sensitive multi-test gas leak detector.

LEAK DETECTION OF HIGH PRESSURE VESSELS

S. Bohátka, I. Berecz, Gy. Horkay and G. Langer

Vacuum 33, (1983) p. 17.

The most sensitive leak detection method for high pressure vessels is based on the use of a mass spectrometer leak detector. Our Q60U type universal quadrupole mass spectrometer was incorporated into the leak test system (type LD-60) designed for the testing of the axial compensators of steam pipings. During manufacture of these items it is possible to detect leak rates ranging from $10^{-9}$ mbar l $s^{-1}$ and $10^{-7}$ mbar l $s^{-1}$ with a response time of 5 min and 5 s, respectively, using a combined slow-fast sampling unit and He as the test gas. The leak detector is pumped by an air-cooled, automatically controlled diffusion pumps system.

GASS CONCENTRATION DETERMINATION IN FERMENTORS WITH QUADRUPOLE MASS SPECTROMETER

S. Bohátka, G. Langer, J. Szilágyi[1)], I. Berecz

1) BIOGAL Pharmaceutical Works, H-4042 Debrecen, Hungary

In the pharmaceutical production it hs a vital importance to determine and control the concentrations of gases involved in the fermentation process. Conventional methods are specific or difficult to handle and a quadrupole mass spectrometer with a sampling unit devised for this purpose proved to be the optimum means for measuring the concentrations of both the exit gases and the gases dissolved in the fermentation broth. The measuring system and examples of mass spectrometric monitoring of fermentation gases are presented.

A PROGRAMABLE QUADRUPOLE MASS SPECTROMETER SYSTEM FOR MULTICHANNEL GAS ANALYSIS

S. Bohátka, I. Berecz, Z. Diós, G. Langer, L. Kiss

3rd Symposium of Socialist Countries on Biotechnology, April 25-29, 1983, Bratislava

QUADRUPOLE MASS SPECTROMETER IN BIOTECHNOLOGY

S. Bohátka

Seminar of Department of Microbiology, University College, Cardiff, 19th Nov, 1983

QUADRUPOLE MASS SPECTROMETER ANALYSER SYSTEM IN FERMENTATION TECHNOLOGY

S. Bohátka

Working Party of European Federation of Biotechnology, Debrecen 25-26, 10, 1983

## THERMAL ANALYSIS OF SOME AMMONIUM COMPOUNDS WITH A MASS SPECTROMETER--DERIVATOGRAPH COMBINATION

S. Bohátka, G. Szöőr[1)], T. Szalay[1)]

1) L. Kossuth University, H-4010 Debrecen, Hungary

IX. International Vacuum Congress, Madrid, 26 Sep. - 1 Oct, 1983

The apparatus is a coupled system of a thermo-analytical device (Q-Derivatograph) and a quadrupole mass spectrometer. The mass and temperature variations of the sample are recorded during a controlled heating period in the derivatograph and the gaseous products are pumped out from the furnace through a two-step pressure reduction system (coupling unit) into the mass spectrometer where the gas is mass-analysed. The setting up of the system is shown.

Simultaneous determination of ammonia and water during the thermal process of compounds is presented.

The thermal behaviour of ammonium paratungstate (APT) and ammonium paramolibdate (APM) and their decomposition products was reinvestigated with this method.

## A NEW POSSIBILITY FOR HIGH-RESOLUTION SPECTROSCOPY OF NUCLEAR PARTICLES ENTERING CR-39 AT SELECTED DIP ANGLES

G. Somogyi, I. Hunyadi, A. F. Hafez[1)] and G. Espinosa[2)]

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[2)] Instituto de Fisica, UNAM, Apartado Postal 20-364, México 20, D. F. México

12th International Conference on SSNTDs, México, Sept 4-10, 1983

In nuclear reaction studies a differentiation of reaction products according to type and energy is generally required. At right angle of incidence a particle identification method based on the relation between the track diameter and particle energy can be well applied to plastic track detectors of low registration sensitivity. We have tried to extend this "track-diamater method" to high-sensitivity CR-39 sheets by selecting special incident angles for particle detection. The utility of such a measuring procedure, called "track-size method", is presented for alpha and proton spectroscopy. A theory is developed to calculate at arbitrary angles the main parameters affecting the resolution power of the "track--size method", namely the critical layer thickness (which has to be removed from the detector surface for track induction) and the depth and minor axis of etch-pits. By using a computer programme it is found that with CR-39, at properly selected dip angles, a high-resolution nuclear spectroscopy can be performed by measuring only the minor axis of tracks of particles resulting from nuclear interactions.

## DEVELOPMENT OF THE DYED-TRACK METHOD FOR KODAK CN-85 DETECTOR

G. Somogyi, M. Tóth-Szilágyi, Zs. Varga, M. Monnin[1] and M. Lferde[1]

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12th International Conference on SSNTDs, México, Sept 4-10, 1983

The dyed-track method has been successfully developed for cellulose derivatives. The track parameters (width, colouration deepness, contrast, registration sensitivity), however, proved to be very dependent on the detector material and track processing conditions. In our previous works optimum conditions were presented mostly for cellulose acetate sheets. In the present work we have studied the influence of track processing parameters on the dyed-track formation in Kodak cellulose nitrate detector called CN-85. It is found that in this material optimum dyed-tracks can be produced with using no swelling but an annealing treatment at 100 °C for 1 hour after particles irradiation. For sensitization a treatment with 15 % HCl at 22°C for 20 hours and for dyeing 0.3 wt% Rhodamine-B at 100°C for 1 hour proved to be the best. For better understanding the track dyeing phenomenon we have studied the colouration behaviour of electron-irradiated CN-85 detectors. The colour deepness (optical density) of the electron-irradiated areas is determined as a function of the electron dose and that of the temperature and duration of annealing applied to the irradiated CN-85 detector.

## MEASUREMENT OF RADON, RADON DAUGHTERS AND THORON CONCENTRATIONS BY MULTI-DETECTOR DEVICES

G. Somogyi, B. Paripás[1] and Zs. Varga

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12th International Conference on SSNTDs, Mexico, Sept 4-10, 1983

There is a growing interest in collection of data concerning human exposures to naturally occurring alpha-emitting radionuclides and their concentration distribution (e.g. in mines, dwellings, building materials, industrial wastes, coal fuel cycle, water supply, soil, plants, etc). Most of such studies are incomplete for the following reasons: 1) In radon measurements the contribution of thoron is generally neglected. 2) The determination of equilibrium factor is complicated or not possible at all. 3) Short- and long-term concentration fluctuations cause difficulties in obtaining representative mean values. 4) The plate-out effect is generally not taken into account. We have studied a variety of simple methods that could be used to overcome some of these difficulties by using measuring cups equipped with two or more alpha-sensitive nuclear track detectors. A theoretical foundation of the quantitative measurements with such devices is presented. Experimental data related to radon, radon daughter products and thoron concentrations measured by multi-detector devices in soil gas and in the air of Hungarian dwellings are reported.

## NEUTRON-INDUCED AUTORADIOGRAPHY BASED ON RELIEF AND DYED IMAGE FORMATION IN POLYMERS

A. Loose[1], I. Hunyadi, G. Somogyi, Zs. Varga, M. Najzer[1] and R. Ilic[1]

1) J. Stefan Institute, E. Kardelj University of Ljubljana

12th International Conference on SSNTDs, Acapulco, Mexico, Sept 4-10, 1983

Neutron-induced autoradiography utilizing formation of a dyed and/or relief image in polymers was developed. The method is based on the detection of neutron-induced charged particles, via (n,p), (n,α), (n,f) reactions and those neutron capture processes leading to internal conversion and/or -decay. Irradiated polymers are treated in water containing an organic dye or in pure water for a few minutes to obtain a dyed and/or relief image, respectively. The fluence of charged particles required to produce a dyed image is between $10^{11}$-$10^{12}$ $cm^{-2}$ which is one order of magnitude less than that for a relief image. Various procedures based on utilization of optical and electron microscopy for contrast enhancement were developed. The techniques were applied to image boron, uranium and gadolinium in solids. Samples were irradiated in the core of a nuclear reactor. The required thermal neutron fluence was between $10^{14}$-$10^{16}$ $cm^{-2}$.

## STUDY OF SPOT DEVELOPMENT AROUND TRACK- AND ELECTRIC-TREE-INDUCED PERFORATIONS THROUGH AN ALUMINIZED TRACK DETECTOR

G. Dajkó and G. Somogyi

12th International Conference on SSNTDs, México, Sept 4-10, 1983

A new method for electrochemical etching of fission and alpha-tracks in thin aluminized plastic detectors was proposed by Tommasino, Zapparoli and Caiazzo at the Bristol conference on SSNTDs (1981). By using the new ECE-method, the electric-tree-induced perforations through nuclear tracks in plastic foils are non-shorting with aluminium at pozitive polarity, due to an anodic oxid formation around the tip of perforations. Therefore, a fast dissolution of the aluminium layer by basic electrolyte can be avoided. We have studied the main trends of the growth of mean diameter of spots dissolved around fission tracks in aluminized, 10 μm thick PET foils as a function of the strength of electric field, frequency of voltage and time of etching in 30% KOH, with using both DC and AC voltages and without using field. It is proved that the electric field greatly enhances the rate of etching along the tracks. With irradiation under vacuum a considerable delay in spot appearance is observed as compared to that obtained with foils irradiated in air. This effect can be partially reduced by using a regeneration period after irradiation. An analyses has indicated that the spot diameter distribution obtained by the new ECE-method can be described by a sum of two curves of lognormal distribution, corresponding to the light and heavy fission tracks.

CURRENT PROBLEMS IN CHEMICAL TRACK ETCHING

G. Somogyi

12th International Conference on SSNTDs, Acapulco, Mexico, Sept 4-10, 1983

A schematic survey is given on the current relevant problems of the etching (or revelation) of multi-track and single-track events in dielectric solids. Some aspects of the research trends and possible new applications ofthe effects observable here, are also considered.

FORMATION OF ION-BEAM IMAGES IN GELATINE AND VARIOUS POLYMERS

G. Somogyi, I. Hunyadi, R. Ilic[1)], A. Loose[1)], and Zs. Varga

1) J. Stefan Institute, E. Kardelj University of Ljubljana

12th International Conference on SSNTDs, Acapulco, Mexico, Sept 4-10, 1983

It has recently been reported by Najzer, Humar and Ilic (1982) that the pure gelatine can be used for producing relief images of high-fluence ion-beams after a treatment in water at room temperature for few minutes. The new method is proposed for high-resolution microradiography of boron in metals via $^{10}B(n,\alpha)^{7}Li$ reaction. In our present work studies are performed to understand the phenomenon observed. We have simulated the image formation by accelerated electron, proton and alpha-particle beams at different fluences. A narrow fluence region is found in which a highly enhanced dissolution rate of the irradiated gelatine is induced. We assume that when the fluence exceeds a critical value (tipically $10^{12}$-$10^{13}$ ions$\cdot$cm$^{-2}$) the damage zones of individual tracks cover almost completely the irradiated area, transforming the irradiated layer into a huge damage zone. In this case the effective diameter of damage zone around a single track has to be $d_{eff}=\phi_c^{-}$ (3-10) nm. We have found that the ion-induced image formation phenomenon observed in gelatine is a more general one and the method may be extended to almost all the etch-track and non-etch-track forming polymers and perhaps to insulating silicates. For example high--resolution $\alpha$-microradiographs have been obtained with CR-39, CN-85, PC and PET sheets and even with hydrate-cellulose known as a non-track-forming material.

DEVELOPMENT OF HIGH-SENSITIVITY TRACK DETECTOR CR-39 FOR STUDYING RELATIVISTIC IONS

G. Somogyi, S. Szilágyi, G. Dajkó

Interkosmos Seminar, Kecskemét, July 19-25, 1983

(In Russian)

CALCULATION OF THERMAL EFFECTS OCCURING DURING THE MANUFACTURE OF CR-39 SHEETS

S. Szilágyi and G. Somogyi

12th International Conference on SSNTDs, Acapulco, Mexico, Sept 4-10, 1983

To manufacture a good-quality, uniform CR-39 track detector, the polymerization rate should be chosen below a critical value to avoid the development of undesirable thermal gradients and internal temperature fluctuations in the sheet being cast. To improve curing cycles, especially for thick CR-39 sheets, a computer programme was developed by which we could study the trends of thermal effects under different casting conditions. Our calculations are based on the solution of the one dimensional heat transport equation, taking into account the relations proposed by Dial et al (1955) for describing the chemical kinetics of CR-39 polymerization. We have revised the empirical parameters available to such calculations. With new "Dial constants" we have calculated the critical initial bath temperature (which results in thermal runaway at the central plane of the sheet being cast) as a function of the CR-39 thickness and IPP initiator concentration. Results are also presented for the temperature profile developing in the depth of cast CR-39 sheets.

DEVELOPMENT OF HIGH-SENSITIVITY CR-39 TRACK DETECTORS FOR CHARGED-PARTICLE RADIOGRAPHY

G. Somogyi, S. Szilágyi, I. Hunyadi, A.F. Hafez

Proc. 13th International Symposium on Autoradiography, Tábor (CSSR), 3-5 May, 1983

Optimum conditons for producing highly radiation-sensitive nuclear track detectors from poly (allyl diglycol carbonate) have been studied. The bulk and track etch properties of CR-39 detector sheets made by the Hungarian Optical Works (MOM) under different conditions were compared with those of some commercially available western CR-39 products. The track registration sensitivity of the sheets to protons, alphas and light ions was measured. A theory is developed to predict the main trends of the appearance and increase of etch-pits in CR-39 detectors. The theoretically and experimentally obtained trends are illustrated for protons and alpha-particles of different energies and angles of incidence. The characteristics of CR-39 track detectors in charged-particle radiography are discussed.

RECENT RESEARCH ACTIVITIES CONCERNING TRACK DETECTORS IN ATOMKI

G. Somogyi, I. Hunyadi

Seminar talk at the J. Stefan Institute, Ljubljana, Reactor Centre 23rd March 1983

OBSERVATION OF NUCLEAR TRACKS ORIGINATING FROM COSMIC RAYS IN THE SOLAR SYSTEM

G. Somogyi

2nd National Paleontological Seminar, Debrecen May 24-27, 1983

MEASUREMENT OF THE $^{12}C(^{12}C,^{8}Be_{g.s.})^{16}O_{g.s.}$ CROSS SECTION AT SUBBARRIER ENERGIES BY PLASTIC DETECTORS

I. Hunyadi, I.M. Szöghy[1] and B. Cujec[1]

1) Université Laval, Québec, Canada G1K 7P4

12 th International Conference on SSNTDs, Acapulco, Mexico, Sept 4-10, 1983

The astrohysically significant yields for the $^{12}C(^{12}C,^{8}Be_{g.s.})^{16}O_{g.s.}$ reaction have been measured at several incident energies between $2.4<E_{c.m.}(MeV)<6.4$, detecting α-particles from the $^{8}Be_{g.s.}$ 2α decay in the forward directions by a Mylar shielded Makrofol-E type polycarbonate foil. The $\alpha_o$ and $\alpha_1$ groups from the $^{20}Ne+\alpha$ channels were separately counted at backward angles in the same foil. Compared to the $\alpha_o$ and $\alpha_1$ groups the yield for the $^{12}C(^{12}C,^{8}Be)^{16}O$ reaction becomes increasingly more important with decreasing energy. The measured angular distributions are indicative of an α-transfer.

EFFECT OF PARTICLE FLUENCE ON TRACK DIAMETER AND RESPONSE OF ELECTRO-CHEMICALLY ETCHED SSNTD

K. Turek[1] and G. Dajkó

1) Institute of Radiation Dosimetry of the Czechoslovak Academy of Sciences, 180 86 Prague

12th International Conference on SSNTDs, Acapulco, Mexico, Sept 4-10, 1983

Track diameter as a function of particle fluence is given for electrochemically etched fission fragment tracks. It is shown that high particle fluences decrease the developability of electrochemically etched tracks. Therefore the dependence of sensitivity on particle fluence was studied for polyester and poly(allyl diglycol carbonate). Continuously decreasing sensitivity was found even in the case when track overlap does not occur. An idea for correct interpretation of the response is suggested.

EFFECT OF PARTICLE FLUENCE ON TRACK DIAMETER AND RESPONSE OF ELECTRO-CHEMICALLY ETCHED SSNTDs

K. Turek[1] and G. Dajkó

1) UDZ, Prága Na Truhlarce 39.

Submitted to: Nuclear Tracks

PRESENT STATUS OF NEUTRON DETECTION IN ATOMKI

L. Medveczky

Proceedings of XI. Regional Congress of IRPA, Austrain-Hungarian--Yugoslavian Radiation Protection Meeting, Vienna, 20-24 Sept 1983

The response of three solid state nuclear track detectors without any external irradiated with neutrons of the spectrum of moderated fission and the counting characteristics of spark counter evaluation on detectors of LR 115 strippable type irradiated with 14.7 MeV neutrons were studied.

NEUTRON INDUCED AND ALPHA AUTORADIOGRAPHY OF ROCKS

L. Medveczky

XIII. Int. Symp. on Autoradiography Tábor (CSSR), 2-5 May 1983

Localization of fissionable content of some granite samples was studied. The samples covered with polyethyleneterephthalate plastic were irradiated in reactor with neutrons of different energy spectrum for preparing fissionograms. In addition to this work, alpha-autoradiograms of the samples were made using IR-115 II type cellulose nitrate and/or CR-39 detectors. Concentrated spots of the fissionable content of the samples were studied with an electron probe X-ray microanalyzer. The results obtained with the different methods are discussed.

NEUTRON SENSITIVITY OF SSNTD

L. Medveczky

Acta Physica Academiae Scientiarum Hungaricae, 52 (1982) 357-362 (3-4)

Various types of solid state nuclear track detectors (SSNTDs) with and without converter radiators were irradiated with neutrons of different energy spectra in order to obtain information on their neutron sensitivity in beam dosimetry. Track revealing was performed by chemical etching. A manual track counting technique was chosen except for the case of thin plastic foils, where also automatic spark counting was used.

REPORT ON THE 12th INTERNATIONAL CONFERENCE ON SSNTDs HELD IN MEXICO (ACAPULCO, SEPTEMBER 4-10, 1983)

G. Somogyi

Seminar talk at the Laboratory of Nuclear Reactions, Dubna, Dec 2, 1983

RECENT STATUS OF THE RESEARCH OF ION-BEAM IMAGE FORMATION

I. Hunyadi, G. Somogyi, Zs. Varga, R. Ilic[1)]

1) Josef Stefan Institute, University of Ljubljana, Ljubljana, Yugoslavia

13th International Symposium on Autoradiography, Tábor, (CSSR) 3-5 May 1983

ION-BEAM IMAGES IN GELATINE

Zs. Varga, G. Somogyi, I. Hunyadi, R. Ilic[1)], A. Loose[1)]

1) Josef Stefan Institute, University of Ljubljana, Ljubljana, Yugoslavia

XIII. Int. Symp. on Autoradiography. Tábor (CSSR) 2-5 May, 1983

Image formation properties of gelatine layers have been studied for different nuclear particles (electrons, protons, alphas). The threshold values of particle fluences for producing stable relief images observable under optical microscope have been determined by sutdying the dissolution rate of irradiated gelatine layers. We have found that the dissolution behaviour of gelatine is very similar to that of the lithographic polymer resists (e.g. PMMA, PBS). A method is developed to improve the contrast of ion-beam images by using proper dying techniques. The high spatial resolution power of the novel radiographic method is illustrated in some typical fields of application (e.g. ion-beam lithography, neutron-induced autoradiography).

RESEARCH ON ATOMIC COLLISION PROCESSES AND ITS IMPORTANCE FOR FUTURE ENERGY SOURCES

D. Berényi

ATOMKI Report B/1 (1983)

APPLICATION OF THE ESCA METHOD IN THE PRODUCTION OF SEMICONDUCTOR INSTRUMENTS

L. Kövér

ATOMKI Report X/3 (1983)

INSTRUMENTAL AND SOFTWARE DEVELOPMENTS AND THEIR APPLICATION IN ELECTRON SPECTROSCOPY

I. Cserny

Thesis for the doctor's degree (PhD)
Kossuth University, Debrecen, 1983
(In Hungarian)

ELECTRON EMITTING BY THIN FILMS

S. Biri

Diploma work, Kossuth University, Debrecen, 1983
(In Hungarian)

ADAPTATION OF A SUPERCONDUCTING SOLENOID TRANSPORTER Si(Li)-Si(Li) SPECTROMETER FOR IN-BEAM STUDIES OF INTERNAL-PAIR TRANSITIONS

A. Passoja*, P. Tikkanen*, A. Krasznahorkay, Z. Gácsi, T. Kibédi and T. Fényes

*Department of Physics, University of Jyväskylä, SF-40100 Jyväskylä, Finland

Submitted to Nucl. Instr. and Meth.

The Debrecen superconducting magnetic spectrometer (SMS) has been adapted for in-beam internal-pair studies. Test measurements have been carried out using a $^{207}$Bi radioactive source and the $^{19}$F(p,αγ)$^{16}$O, $^{23}$Na(p,αγ)$^{20}$Ne, $^{27}$Al(p,p'γ)$^{27}$Al, and $^{42}$Ca(p,p'γ)$^{42}$Ca reactions (at bombarding energies $E_p$=3.5-4.0 MeV). Convenient spectrometer parameters and backscattering of electrons and positrons from one detector to the other have been investigated. Experimental values of (14±3)%, (12±3)%, and (14±2)% for the one detector pair-line efficiences were determined for the $^{20}$Ne(E2; 1634 keV), $^{42}$Ca(E0; 1836 keV), and $^{27}$Al(M1+E2; 2211 keV) transitions, respectively. The observed pair-line detection efficiences for two detectors operated in sum-coincidence mode were (35±7)% and (34±6)% for the $^{42}$Ca(E0; 1836 keV) and $^{27}$Al(M1+E2; 2211 keV) transitions, respectively. The energy resolution of the spectrometer was ~0.5% in singles and ~0.6% in sum-coincidence measurements for the 2211 keV M1+E2 pair line of $^{27}$Al. Effective pair-formation coefficients for one-detector and opposite two-detector geometries have been calculated theoretically for various multipoles. Different methods for the determination of the multipolarity of internal-pair transitions have been investigated. Optimum multipole discrimination effects have been discussed. The experiments show that a good multipole discriminating power can be achieved with the SMS. See fig.

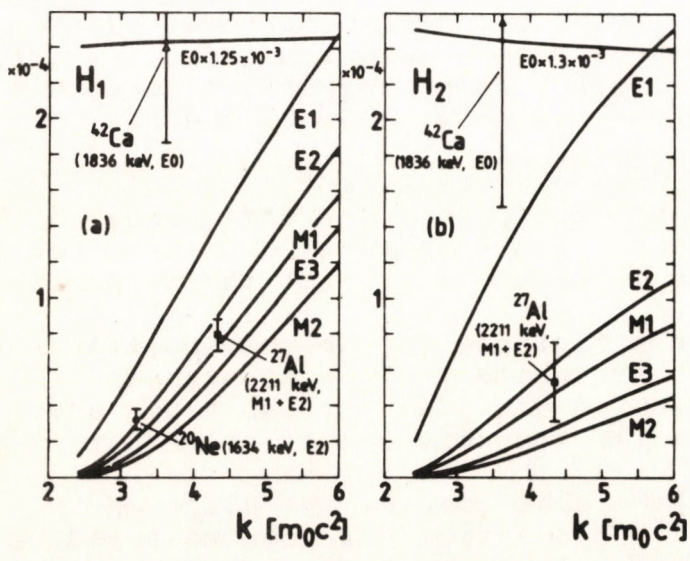


Fig. The transition energy dependence of effective pair formation coefficients in one-detector ($H_1$) and opposite-detector ($H_2$) geometries. Curves: results calculated in zero order Born approximation. Poins with error bars: experimental data.

MINIORANGE ELECTRON SPECTROMETER FOR IN-BEAM MEASUREMENTS

J. Gulyás, A. Domonyi, T. Kibédi, A. Krasznahorkay, T. Fényes, Zs. Schram

ATOMKI Preprint E/1 (1983) 1-10
(In Russian)

An electron spectrometer of "miniorange" type is described. The main parts of the spectrometer are as follows: reaction chamber, lock system for quick change of targets, RECOMA permanent magnets, Si(Li) detector, and adjoining electronic instruments. The maximum efficiency of electron registration in peak may reach 10 % (from $4\pi$) and the resolution of the spectrometer is 2 keV at $E_e$=177 keV (FWHM under in-beam conditions). The energy interval of electron transmission may be changed with relative shifting of the magnet frame and detector without breaking vacuum. Study of the conversion electron spectra of nuclear reactions showed that an effective background reduction may be achieved by the use of the spectrometer.

CONSTRUCTION AND TESTING OF A MINI-ORANGE ELECTRON SPECTROMETER

Zs. Schram

Diploma Work, Kossuth University, Debrecen, 1983.
(In Hungarian)

A mini-orange spectrometer (MOS) has been constructed for in-beam conversion spectroscopy. It consists of three parts which are: the reaction chamber with a target holder, the orange type magnetic filter which is made from wedgeshaped permanent magnets, and a Si(Li) detector placed at 125° to the beam direction.

The spectrometer separates electrons from high background components of $\alpha$,$\beta^+$, $\gamma$, X and $\delta$-radiation. The efficiency of the MOS have been measured at several arrangements and numerical calculations have been done in order to predict the transmitted energy ranges.

The absolute detection efficiency of the spectrometer depends on the experimental arrangement (type of magnets, target-filter-detector distances etc.) and it can reach about 10%. It is easy to optimize the transmission of the MOS to a given problem.

As an in-beam test of the spectrometer the electron spectrum of the $^{70}Zn(p,ne^-)^{70}Ga$ reaction has been measured. To observe new conversion electron lines of this reaction an effective background suppression method has been developed.

A COMBINATION SUPERCONDUCTING MAGNETIC PLUS Si(Li) SPECTROMETER FOR IN-BEAM STUDIES OF INTERNAL-PAIR TRANSITIONS

A. Passoja[1)], T. Fényes, Z. Gácsi, T. Kibédi, A. Krasznahorkay, P. Tikkanen[1)]

1) University of Jyväskylä, Department of Physics

Proc. Int. Conf. on Nuclear Physics. Florence, August 29 - September 3, 1983. Vol: 1. p. 735

A COMBINATION SUPERCONDUCTING MAGNETIC PLUS Si(Li) SPECTROMETER FOR IN-BEAM STUDIES OF INTERNAL-PAIR TRANSITIONS

A. Passoja[1)], T. Fényes, Z. Gácsi, T. Kibédi, A. Krasznahorkay, P. Tikkanen[1)]

1) University of Jyväskylä, Department of Physics

Annual Meeting of the Finnish Physical Society, Joensuu, Finland, February 11-12, 1983

ADAPTATION OF A SUPERCONDUCTING SOLENOID TRANSPORTER Si(Li)-Si(Li) SPECTROMETER FOR IN-BEAM STUDIES OF INTERNAL-PAIR TRANSITIONS

A. Passoja[1)], P. Tikkanen[1)], A. Krasznahorkay, Z. Gácsi, T. Kibédi, T. Fényes

1) University of Jyväskylä, Department of Physics

Seminar talk at the University of Kentucky, Department of Physics and Astronomy, Lexington November 2, 1983

INTERNAL POSITRON-ELECTRON PAIR DETECTION

Z. Gácsi

Kentucky Association of Physics Teachers, Fall Meeting, November 11-12, University of Louisville, Kentucky, USA

QUICK METHODS FOR THIN POWDER TARGET PREPARATION

Zs. Dombrádi, T. Kibédi, S. László

ATOMKI Report E/3 (1983) 1-3.

Several methods for preparation of powder targets in the mg/cm$^2$ range are described and compared. For improving the uniformity of targets a procedure based on redimentation was introduced.

MEASUREMENT OF NOISE IN TWO RF SQUID SYSTEMS

S. Mészáros, K. Vad, R. Tichy[1)], V. Petricek[1)]

[1)]Institute of Physics of the Czechoslovak Academy of Sciences

Submitted to: Czechoslovak Journal of Physics

Detailed experimental investigations of noise properties of SQUIDs developed in the Institute of Physics of the Czechoslovak Academy of Sciences and in the Institute of Nuclear Research of the Hungarian Academy of Sciences (ATOMKI) are described. The measurements include the determination of probability distribution functions (PDF's) and the power spectra of the intrinsic noise of SQUIDs. A short review of noise theory is given. A noise analyser developed in ATOMKI is discussed together with the results obtained with it. It is concluded that these SQUIDs have a flat noise spectrum with Gaussian PDF (above 1/f noise). The absolute values of equivalent flux noise ($7.7 \times 10^{-5}$ $\Phi_0/\sqrt{Hz}$ for Prague SQUID system biased at 38 MHz and $1.8 \times 10^{-4}$ $\Phi_0/\sqrt{Hz}$ for Debrecen SQUID system biased at 10 MHz) are comparable to the best values reported in the literature of similar SQUID systems.

A SIMPLE DIRECTIONAL COUPLER FOR RADIOFREQUENCY RANGE

S. Mészáros, K. Vad

Submitted to: Journal of Physics E: Scientific Instruments

The construction theory of a new type, very simple directional coupler for the frequency range from 1 MHz to 1 GHz is described. It is made of two pieces of a coaxial cable and two capacitors. The application of these directional couplers for RF SQUIDs is also described.

NOISE COMPARISION OF TWO RF SQUID SYSTEMS

S. Mészáros, K. Vad, V. Petricek[1)], R. Tichy[1)]

1) Inst. of Physics CSAV, Praha

3rd Czechoslovak Symposium on Weak Superconductivity (24-29 April 1983, Smolenice)

DEVELOPMENT OF A CCD BASED SYSTEM CALLED DIGITRACK FOR AUTOMATIC TRACK COUNTING AND EVALUATION

J. Molnár, G. Somogyi, S. Szilágyi and K. Sepsy

12th International Conference on SSNTDs, Mexico, Sept 4-10, 1983

Rather expensive and unflexible commercial systems have been reported in the literature for fully automatic counting and analyzing etched nuclear tracks. In these systems the image processing is made by a videocamera equipped with a microscope of relatively high magnification. We have developed, to best of our knowledges, the first automatic track analysis system (DIGITRACK) in which the video signals are processed by a new type of videoreceiver called charged coupled device (CCD). The photosensitive semiconductor device is a 2.5 cm long line imager of type Fairchild CCD 121HC which converts one row of the picture seen through a low magnification microscope into 1728 binary signals by a thresholding logic. The picture elements are analysed by a microcomputer equipped with two INTEL 8080 microprocessors and interfaced to a PDP-11/40 computer. The microcomputer also controls the motion of the stage of microscope. For pattern recognition and analysis a software procedure is developed which is able to differentiate between overlapping tracks and to determine the number, surface opening and x-y coordinates of the tracks occurring in a given detector area. The distribution of track densities and spot areas on the detector surface can be visualized on a graphic display. The DIGITRACK system has been tested for analysis of alpha-tracks registered in CR-39 and LR-115 detectors.

SIMPLE DEAD-TIME AND PILE-UP CORRECTION TECHNIQUE USING A GATED PERIODIC PULSE TRAIN

J. Gál and Gy. Bibok

Nuclear Instruments and Methods 206 (1983) 465-469

In a pulse-height analysis system using a gated periodic pulse train for the correction of counting losses, it is shown that both the dead-time and pile-up losses can be corrected for if the clock pulses have the same width as the so called true pile-up time of the pulse processing system, and the clock pulses are rejected from the pulse train if a coincidence between the shaped clock pulses and the busy time of the system is detected. The technique was tested both with random-pulse generators and a Ge(Li) detector ($^{60}$Co and $^{137}$Cs sources). At counting rate up to 50 kHz, it is shown that the correction was accurate to $\pm$1%.

DYNAMIC RAM MEMORY DEVELOPED FOR MICROPROCESSOR

Cs. Sándor

Diploma thesis Kossuth University, 1983
(In Hungarian)

A NEW AUTOMATIC TRACK COUNTING AND ANALYSING SYSTEM: THE DIGITRACK

J. Molnár, G. Somogyi, S. Szilágyi, K. Sepsy

Proc. 13. International Symposium on Autoradiography, Tábor (CSSR), 3-5 May 1983, p. 90

A microprocessor supported instrument called DIGITRACK has been developed for evaluation of etch-track parameters in solid state nuclear track detectors. The picture analysis is performed by a photosensitive semiconductor device of type Fairchild CCD 121HC mounted on a Leitz Ortholux microscope. One row of the picture is converted into 1728 binary signals by a tresholding logic. The picture elements are analysed by a microcomputer equipped with INTEL 8080 microprocessors. The pattern recognition software procedure separates the overlapping tracks and determines the number, surface area and x-y coordinate of the tracks in a given detector area. The distribution of track sizes and spatial track densities in a radiogram can be visualized on a graphic display. As the DIGITRACK system works at low microscopic magnification (2-10 x), the automatic track evaluation can be performed at high speed.

A NEW AUTOMATIC TRACK COUNTING AND ANALYSING SYSTEM: THE DIGITRACK

J. Molnár, G. Somogyi, S. Szilágyi, K. Sepsy

Proceedings of the Third Symposium on Microcomputer and Microprocessor Application Budapest, 18-21, Oct, 1983. Vol: 2.

AMPLIFIER AND SIGNAL PROCESSOR SYSTEMS WITH TIME VARIANT PARAMETERS FOR SEMICONDUCTOR RADIATION-DETECTORS

T. Lakatos

Thesis for the candidate of science degree
(In Hungarian)

NEW PRINCIPLES AND METHODS FOR IMPROVING THE PARAMETERS

J. Gál

Thesis for the candidate of science degree
(In Hungarian)

MEASURING METHODS AND CIRCUIT REALISATIONS FOR IMPROVING THE ACCURACY OF THE ENERGY AND TIME SPECTROSCOPIC INSTRUMENTS

Gy. Bibok

Thesis for the candidate of science degree
(In Hungarian)

A NEW SOLUTION OF CONSTANT FRACTION TIMING

Gy. Bibok, J. Gál

XI. International Symposium on Nuclear Electronics, 6-12 September, 1983, Bratislava

DATA ACQUISITION AND PROCESSING SYSTEM OF ENERGY DISPERSIVE X-RAY SPECTROMETER WITH MICROPROCESSOR

G. Horkay, M. Kis-Varga, T. Lakatos, J. Molnár, M. Zsurzs

XI International Symposium On Nuclear Electronics 6-12 Sept 1983, Bratislava

DEVELOPMENT SYSTEM FOR SIGNETICS 8x300 BIPOLAR MICROPROCESSOR BASED ON AN 8080 MICROCOMPUTER SUPPORTED BY PDP-11 MINI

K. Juhász, S. Lőkös, J. Szádai

µP'83 Third Symposium on Microcomputer and Microprocessor Application, 18-21. Oct. 1983. Budapest

RAM MASS-STORAGE DEVICE WITH 8x300 MICROPROCESSOR CONTROLLER

K. Juhász, S. Lőkös, J. Szádai

µP'83 Third Symposium on Microcomputer and Microprocessor Application, 18-21. Oct. 1983. Budapest

MICROCOMPUTER CONTROLLED X-RAY EMISSION ANALIZER (REA)

S. Lőkös

Microprocessors in Medical Technics Esztergom, 6-7, Oct 1983.

LOCAL NETWORK IN THE DATA ACQUISITION AND PROCESSING SYSTEM OF A CYCLOTRON LABORATORY

S. Lőkös

Seminar on Local Networks, Debrecen, 18-19 April, 1983

## LECTURES AND SEMINARS*

January 21.
Studies of (p,n) and (p,γ) nuclear reactions on the proton beam of the Indiana cyclotron
P. Koncz (KFKI)
(In Hungarian)

January 27.
Solid state nuclear track evaluation with CCD
J. Molnár
(In Hungarian)

February 3.
Plasma physics on TOKAMAK
A. Montvai (KFKI)
(In Hungarian)

February 10.
Cyclotron produced radioisotopes in the Pulmonology
L. Kertész (Korányi Kórház Budapest)
(In Hungarian)

February 17.
Investigation of the Excited States of $^{98}$Tc Nucleus
T. Kibédi
(In Hungarian)

February 24.
Investigation of the Excited Levels of $^{76}$As and $^{82}$Br Nuclei
Z. Gácsi
(In Hungarian)

March 3.
Bound and resonant single-particle states in deformed potential
B. Gyarmati, A. Kruppa, Z. Papp, Gy. Wolf
(In Hungarian)

March 10.
Development and research work in the PIXE-group of the DHAKA Atomic Energy Centre
E. Koltay
(In Hungarian)

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*Held weekly on Thursdays at 2 o'clock pm.

March 24.
Explanations of internal conversion anomalies by generalized exchanges corrections
E. Vatai
(In Hungarian)

March 31.
X-ray analysis
Prof. H. Ebel (Technische Universitat, Wien)
(In Hungarian)

April 14.
Development of measuring methods and circuits for the improvement of measuring accuracy of energy and time spectroscopic instruments
Gy. Bibok
(In Hungarian)

April 28.
Low energy elastic scattering on $^{19}F$, $^{116,120}Sn$ nuclei
L. Zolnai
(In Hungarian)

May 5.
Decay Energies of Neutron Deficiant Rare-Earth Isotopes
F. Tárkányi
(In Hungarian)

May 12.
High-spin states in the lead region
Dr. B. Fant

May 19.
Resonant reactions of light nuclei and the nuclear molecules
J. Cseh
(In Hungarian)

May 26.
Levels of $^{14}N$ from the analysis of Doppler broadened $\gamma$-lines in the $^{10}B(\alpha,p\gamma)^{13}C$ reaction
É. Pintye (DOTE)
(In Hungarian)

June 2.
Reduction of continuous $\beta$-background with beam-pulser in in-beam conversion electron spectroscopic measurements
Report on the Rossendorf-Rez-Cracow-Kiev seminar
A. Krasznahorkay
(In Hungarian)

June 9.
$e^-$-$e^+$ internal pair formation studies with SMS
Z. Gácsi

The ATOMKI mini-orange spectrometer
T. Kibédi
(In Hungarian)

June 16.
Inner shell ionization by heavy charged particles
Prof. J.M. Hansteen (University of Bergen, Norway)

June 23.
Development of energy dispersive X-ray spectrometer and its inter-disciplinary applications
J. Bacsó
(In Hungarian)

June 30.
Situation and development of the national technical-literature informating
M. Ágoston (Budapest)
(In Hungarian)

September 1.
Calculations and measurements on the stopping of recoil atomic nuclei related to the Application of Doppler effect in nuclear spectroscopy
M.M. Abdel Hady (Ain thams University, Cairo, Egypt)

September 8.
Research in Physics in Portugal
Prof. J.G. Ferreira (University of Lisboa, Portugal)

September 15.
Ion-atom scatterings with high energy heavy ions
D. Berényi
(In Hungarian)

September 22.
XPS surface investigations and corresponding instrumental - methodical studies
I. Kádár
(In Hungarian)

October 6.
The synchroton radiation in research
L. Cser (KFKI)
(In Hungarian)

October 15.
Excited states of the $^{70}$Ga nucleus
J. Timár
(In Hungarian)

Report on the "International Conference on Nuclear Physics, Florence, August 28 - September 3, 1983"
T. Fényes
(In Hungarian)

October 27.
Recent results of the IBA model
Prof. P. Lipas (Jyväskylä, Finland)

November 10.
Quadrupole mass-spectrometric measuring system of fermentors
S. Bohátka
(In Hungarian)

November 17.
Programmable peak selector and data acquisition system for quadrupole mass-spectrometer
Z. Diós
(In Hungarian)

November 24.
Reconstruction of the ESA-11
J. Tóth
(In Hungarian)

December 1.
Newest results in the investigation of high spin states of A 150 nuclei
B. Nyakó
(In Hungarian)

December 8.
Development in connection with preparation and measurements of Si(Li) detectors
J. Pálvölgyi
(In Hungarian)

December 15.
Report on actual problems of ATOMKI
D. Berényi
(In Hungarian)

# AUTHOR INDEX

Kiadja a
Magyar Tudományos Akadémia
Atommagkutató Intézete

A kiadásért és szerkesztésért felelős
Dr. Berényi Dénes az Intézet igazgatója
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